DOCUMENT RESUME

ED 305 247 SE 050 444

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TITLE Computer Managed Instruction Homework Modules for Calculus I.
PUB DATE Sep 88
NOTE 52p.
PUB TYPE Guides - Classroom Use - Materials (For Learner) (051) -- Tests/Evaluation Instruments (160)

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS *Analytic Geometry; *Calculus; *College Mathematics; Higher Education; Mathematical Enrichment; Mathematics; *Mathematics Materials; *Mathematics Tests; Problem Sets

ABSTRACT

This booklet contains 11 modules (290 multiple-choice items) designed for use in the first course of a three-course calculus sequence using the textbook "Calculus with Analytic Geometry" (Dennis G. Zill). In each module, relevant sections of the textbook are identified for users. It can, however, be used in conjunction with any calculus textbook. (Author/YP)

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ED305247

Computer Managed Instruction

Homework Modules

for

Calculus I

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SE 050 444

The following set of modules were designed for use in the first course of a three course Calculus sequence using the textbook: Calculus with Analytic Geometry by Dennis G. Zill. It can however be used in conjunction with any Calculus textbook.

MATH 3022 - MODULE 1 September 1988

Section 1.1 (Problems 1-15)
Section 1.2 (Problems 16- 27)

1. The solution set of the inequality $x^2 + x - 6 \geq 0$ is:
   a) $-3 \leq x \leq 2$ b) $2 \leq x \leq -3$ c) $x \leq -3$ or $x \geq 2$
   d) $x \leq -2$ or $x \geq 3$ e) none of the above

2. The solution set of the inequality $x^2 + x + 6 > 0$ is:
   a) $2 < x < 3$ b) the empty set c) $x < 2$ or $x > 3$
   d) all real numbers e) $-6 < x < -1$

3. The solution set of the inequality $-2x^2 + 12x - 10 > 0$ is:
   a) $1 < x < 5$ b) $-5 < x < -1$ c) $x < 1$ or $x > 5$
   d) all real numbers e) the empty set

4. The solution set of the inequality $-x^2 - 8x < 0$ is:
   a) $x < -8$ and $x > 0$ b) $x < -8$ or $x > 0$ c) the empty set
   d) $0 < x < 8$ e) all real numbers

5. The solution set of the inequality $4x^2 - 8x - 5 \leq 0$ is:
   a) all real numbers b) $x \leq -\frac{1}{2}$ or $x \geq \frac{5}{2}$ c) $-1 \leq x \leq \frac{5}{4}$
   d) $-\frac{1}{2} \leq x \leq \frac{5}{2}$ e) the empty set

6. The solution set of the inequality $\frac{x - 6}{x + 2} \geq 0$ is:
   a) $-2 \leq x \leq 6$ b) $x \leq -2$ or $x \geq 6$ c) $x < -2$ or $x \geq 6$
   d) $-2 < x \leq 6$ e) all real numbers

7. The solution set of the inequality $\frac{x^2 - 9}{4 - x} < 0$ is:
   a) $(-3,3) \cup (4,+\infty)$ b) $(-\infty,-3) \cup (3,4)$ c) $(-\infty,3) \cup (4,\infty)$
   d) $(-3,4)$ e) the empty set

8. The solution set of the inequality $\frac{x^2 + 4}{x + 1} \leq 0$ is:
   a) $(-2,-1) \cup [2,\infty)$ b) $(-\infty,-2] \cup (-1,2]$ c) $(-\infty,-1]$
   d) $x < -1$ e) the empty set

9. The solution set of the inequality $\frac{3 - x^2}{x^4} \geq 0$ is:
   a) $[-\sqrt{3}, \sqrt{3}]$ b) $x \leq -\sqrt{3}$ or $x \geq \sqrt{3}$ c) $[-\sqrt{3},0) \cup (0,\sqrt{3}]$
   d) $[-3,0) \cup (0,3]$ e) all real numbers

10. The solution set of the inequality $\frac{x^2 - 1}{x^3} < 0$ is:
    a) $x < -1$ or $0 < x < 1$ b) $(-1,0) \cup (1,\infty)$ c) $x < 0$ or $x > 1$
    d) all real numbers e) the empty set

11. The solution set of the inequality $|x - 7| < 4$ is:
    a) $-4 < x < 4$ b) $x < 3$ or $x > 11$ c) $-11 < x < -3$
    d) $3 < x < 11$ e) the empty set

12. The solution set of the inequality $|x + 2| \leq 9$ is:

a) the empty set b) $-7 \leq x \leq 11$ c) $-11 \leq x \leq 7$

d) $-9 \leq x \leq 9$ e) all real numbers

13. The solution set of the inequality $|2x - 6| \leq -5$ is:

a) the empty set b) $\frac{1}{2} \leq x \leq \frac{11}{2}$ c) $-\frac{11}{2} \leq x \leq -\frac{1}{2}$

d) $-5 \leq x \leq 5$ e) all real numbers

14. The solution set of the inequality $|3x - 2| > 1$ is:

a) $x < -1$ or $x > 1$ b) $x < \frac{1}{3}$ or $x > 1$ c) $1 < x < \frac{1}{3}$

d) $-1 < x < -\frac{1}{3}$ e) all real numbers

15. The solution set of the inequality $|x + \frac{1}{5}| \geq 6$ is:

a) $x \leq -\frac{31}{5}$ or $x \geq \frac{29}{5}$ b) $x \leq -\frac{29}{5}$ or $x \geq \frac{31}{5}$ c) $\frac{29}{5} \leq x \leq -\frac{31}{5}$

d) the empty set e) all real numbers

16. The triangle with vertices (-1,3), (1,2) and (5,10) is:

a) isosceles b) right c) both of the above d) none of the above

17. The graph of the equation $x^6 + 2 = y^3$

a) is symmetric with respect to the x-axis
b) is symmetric with respect to the y-axis
c) is symmetric with respect to the origin
d) all of the above
e) has no symmetries

18. The graph of the equation $x^5y^4 - 2x^2y^2 = y^6$

a) is symmetric with respect to the x-axis
b) is symmetric with respect to the y-axis
c) is symmetric with respect to the origin
d) all of the above
e) has no symmetries

19. The graph of the equation $x^5 + y^5 = xy$

a) is symmetric with respect to the x-axis
b) is symmetric with respect to the y-axis
c) is symmetric with respect to the origin
d) all of the above
e) has no symmetries

20. The graph of the equation $x^5y^5 = 1$

a) is symmetric with respect to the x-axis
b) is symmetric with respect to the y-axis
c) is symmetric with respect to the origin
d) all of the above
e) has no symmetries

21. The graph of the equation $(x - 3)^2 + (y + 5)^2 = 9$ is a circle with:

a) center (3,5), radius 3 b) center (3,5), radius 9

c) center (3,-5), radius 3 d) center (3,-5), radius 9

e) none of the above

22. The graph of the equation $x^2 + (y - 1)^2 = 5$ is a circle with:

a) center (1,0), radius 5 b) center (0,-1), radius $\sqrt{5}$

c) center (0,1), radius 5 d) center (0,1), radius $\sqrt{5}$

e) none of the above

23. The circle whose diameter has endpoints (5,11) and (1,-3) has its center at:

a) (3,7) b) (3,4) c) (2,7) d) (2,4) e) none of these

24. The circle whose center is at (-1,6) and with radius 4 is:

a) $(x - 1)^2 + (y + 6)^2 = 4$ b) $(x - 1)^2 + (y + 6)^2 = 16$

c) $(x + 1)^2 + (y - 6)^2 = 4$ d) $(x + 1)^2 + (y - 6)^2 = 16$

e) none of the above

25. The circle with center (1,2) and passing through (4,6) is:

a) $(x - 1)^2 + (y - 2)^2 = 25$ b) $(x - 1)^2 + (y - 2)^2 = 5$

c) $(x + 1)^2 + (y + 2)^2 = 5$ d) $(x + 1)^2 + (y + 2)^2 = 16$

e) none of the above

26. The equation $x^2 + y^2 - 8x + 2y + 1 = 0$ is:

a) a point b) a circle with center (4,-1) and radius 4 c) no graph

d) a circle with center (4,-1) and radius 1 e) none of these

27. The equation $4x^2 + 4y^2 - 4x + 12y - 10 = 0$ is:

a) a point b) a circle with center $(\frac{1}{2},-\frac{3}{2})$ and radius 5

c) a circle with center $(\frac{1}{2},-\frac{3}{2})$ and radius $\sqrt{5}$ d) no graph

e) none of the above

MATH 3022 - MODULE 2

Section 1.3 (Problems 1-10)
Section 1.4 (Problems 11-19)
Section 1.5 (Problems 20-25)

1. The slope of the line through the points (2,-3) and (7,1) is:
   a) $\frac{4}{5}$ b) $\frac{6}{5}$ c) $\frac{5}{4}$ d) $\frac{-2}{9}$ e) does not exist

2. The slope of the line through the points (2,6) and (2,-3) is:
   a) 0 b) $\frac{3}{4}$ c) $\frac{4}{3}$ d) does not exist e) none of the above

3. An equation of the line passing through the points (5,3) and (0,5) is:
   a) $5y - 2x - 25 = 0$ b) $5y + 2x - 25 = 0$ c) $y = 5$
   d) $x = 5$ e) does not exist

4. An equation of the line passing through the points (-3,5) and (-3,-4) is:
   a) $(y - 5) = \frac{3}{2}(x + 3)$ b) $(y + 4) = -\frac{3}{2}(x + 3)$ c) $y = -3$
   d) $x = -3$ e) does not exist

5. An equation of the line passing through the point (-5,-7) and has y-intercept -7 is:
   a) $x = -7$ b) $y = -7$ c) $x + 5 = -7(y + 7)$ d) $y = -5x - 7$
   e) none of the above

6. The slope of the line $3y - 2x + 7 = 0$ is:
   a) -2 b) 3 c) $\frac{2}{3}$ d) $-\frac{2}{3}$ e) does not exist

7. An equation of the line passing through (-5,8) and parallel to the line $x = 4$ is:
   a) $y = 8$ b) $y - 8 = (x + 5)$ c) $x = -5$ d) $x = -20$
   e) does not exist

8. An equation of the line passing through the point (2,-3) and perpendicular to the line $3y + 7x - 3 = 0$ is:
   a) $y + 3 = \frac{7}{3}(x - 2)$ b) $y + 3 = 7(x - 2)$ c) $y + 3 = -\frac{1}{7}(x - 2)$
   d) $7y - 3x + 27 = 0$ e) $3y + 7x - 5 = 0$

9. An equation of the line passing through the point (-3,5) and perpendicular to the line $y = 10$ is:
   a) $x = -6$ b) $y = 5$ c) $y - 5 = x + 3$ d) does not exist
   e) none of the above

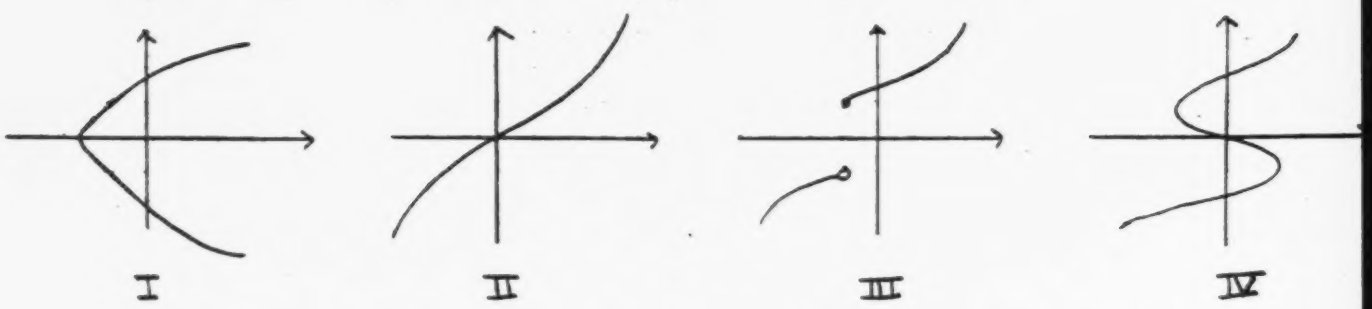
10. If the line $3x + ky + 5 = 0$ is perpendicular to $-2x + 7y - 3 = 0$ then k is:
    a) 7 b) $-\frac{1}{7}$ c) $-\frac{6}{7}$ d) $\frac{6}{7}$ e) $\frac{7}{2}$

11. Given $f(x) = \sqrt{x + 4}$, if $h \neq 0$ then $\frac{f(x + h) - f(x)}{h}$ is:
    a) 1 b) $\frac{1}{\sqrt{x + h + 4} - \sqrt{x + 4}}$ c) $\frac{1}{\sqrt{x + h + 4} + \sqrt{x + 4}}$
    d) none of the above

12. Given $f(x) = \begin{cases} 2x-3 & x < -5 \\ x^2 & x = -5 \\ x+7 & x > -5 \end{cases}$ then $f(-6) + 2f(6) =$

a) 3 b) 11 c) 36 d) 27 e) all of the above

13. Given the following graphs, which are functions?



a) I only b) II only c) II and III only d) I and IV only
e) II, III and IV only

14. The function $f(x) = 3x^7 - 5x^5 + x$ is:

a) odd b) even c) odd and even d) neither even nor odd

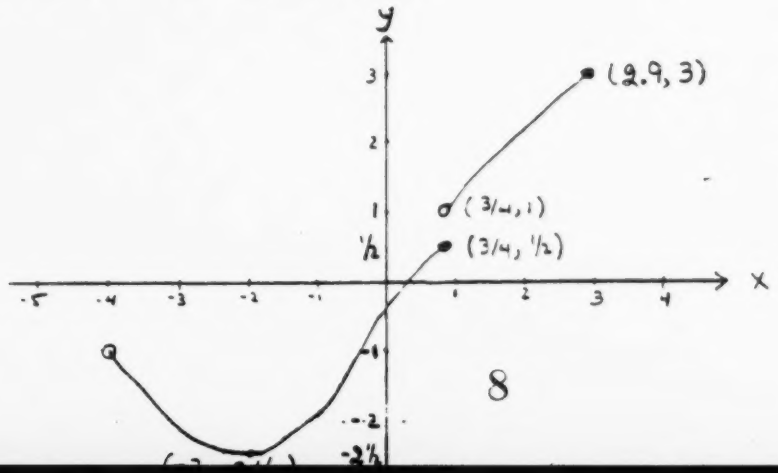
15. The function $f(x) = \dfrac{|x - 1|}{3x}$ is:

a) odd b) even c) odd and even d) neither even nor odd

16. Given the graph of a function f, which of the following statements are true?

(I) The domain of $f = \{x \mid -4 < x \leq 2.9\}$
(II) The domain of $f = \{x \mid -4 < x \leq 3\}$
(III) The range of $f = \{y \mid -1 < y \leq 3\}$
(IV) The range of $f = \{y \mid -4 < y \leq 2.9\}$
(V) The range of $f = \{y \mid -2\frac{1}{2} \leq y \leq 3\}$
(VI) The range of $f = \{y \mid -2\frac{1}{2} \leq y \leq \frac{1}{2}\} \cup \{y \mid 1 < y \leq 3\}$

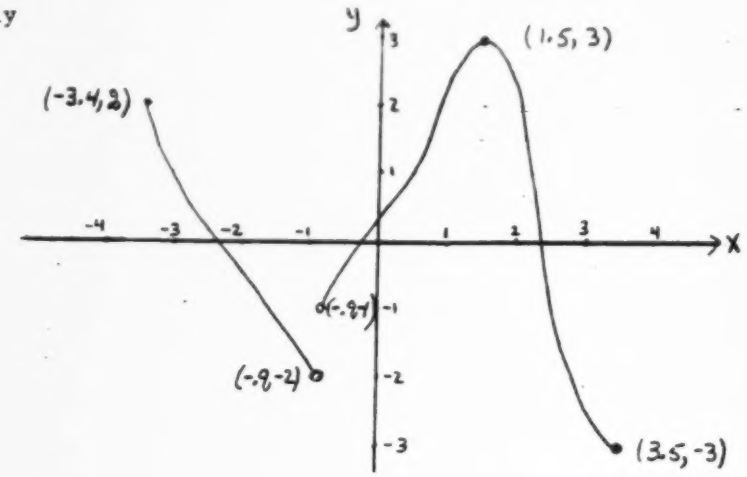
a) I and IV only b) I and III only c) II and III only
d) I and V only e) I and VI only



17. Given the graph of a function g, which of the following statements are true?

(I) The domain of g = $\{x \mid -3.4 \leq x \leq 3.5\}$
(II) The domain of g = $\{x \mid -3.4 \leq x < -.9\} \cup \{x \mid -.9 < x \leq 3.5\}$
(III) The range of g = $\{y \mid -3 \leq y \leq 3\}$
(IV) The range of g = $\{y \mid -2 < y \leq 2\}$

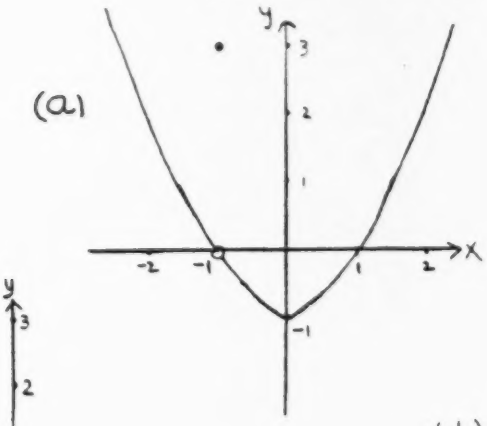
a) II and III only b) I and III only c) II and IV only
d) I and IV only e) II only

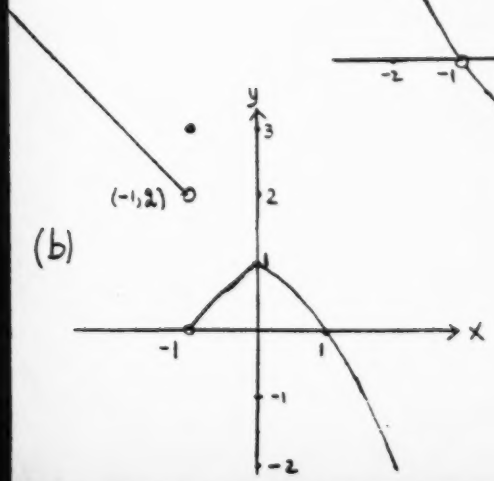


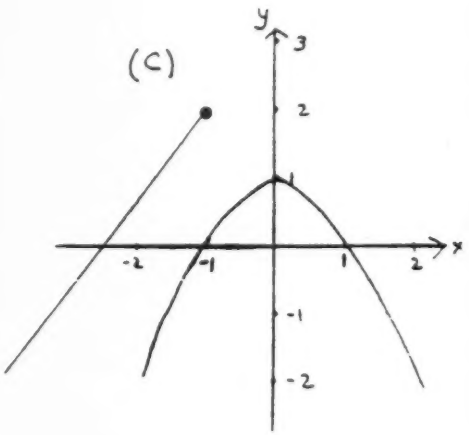
18. Given $f(x) = \begin{cases} x + 4 & x < 2 \\ x^2 + 1 & x \geq 2 \end{cases}$. f(x) = 5 if:

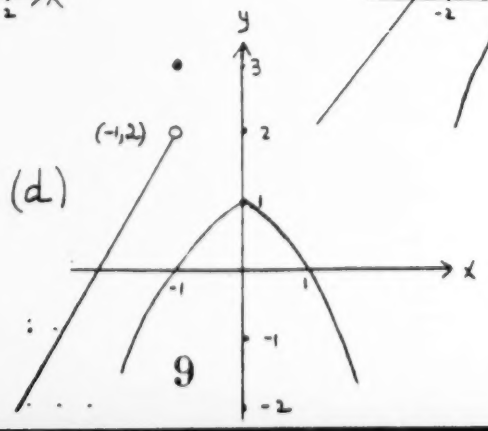
a) x = 2 only b) x = 1 only c) x = 2 and x = -2 only
d) x = 2, x = -2 and x = 1 only e) none of the above

19. Given $f(x) = \begin{cases} -x + 1 & x < -1 \\ 3 & x = -1 \\ -x^2 + 1 & x > -1 \end{cases}$ the graph of f is:









20. Given $f(x) = 3x^2 + 4$ and $g(x) = 5x^4 - 2x^2$ then $(f \cdot g)(x)$ is:
    a) $15x^8 - 14x^4 - 8x^2$ b) $15x^6 - 14x^4 - 8x^2$ c) $15x^6 + 3x^4 - 8x^2$
    d) $21x^2$ e) none of the above

21. Given $h(x) = 2 \sin x$ and $g(x) = x^3 + 5$ then $(h \circ g)(x)$ is:
    a) $2 \sin (x^3 + 5)$ b) $8 \sin^3 x + 5$ c) $(2 \sin x)(x^3 + 5)$
    d) $2 \sin (x^4 + 5x)$ e) none of the above

22. Suppose $(f \circ g)(x) = 6(x^3 + 4x)^{10}$ and $g(x) = x^3 + 4x$ then $(2f + g)(x)$ is:
    a) $12x^{10} + x^3 + 4x$ b) $12(x^3 + 4x)^{10} + x^3 + 4x$ c) $2(6x^{10} + x^3 + 4x)$
    d) $12(x^3 + 4x)^{10}$ e) none of the above

23. Suppose $(f \circ g)(x) = 7 \sin (x^5 - 10x)$ and $f(x) = 7 \sin x$ then $(g/f)(x)$ is:
    a) $x^5 - 10$ b) $1/(x^5 - 10)$ c) $x^4 - 10$ d) $(x^5 - 10x)/7 \sin x$
    e) none of the above

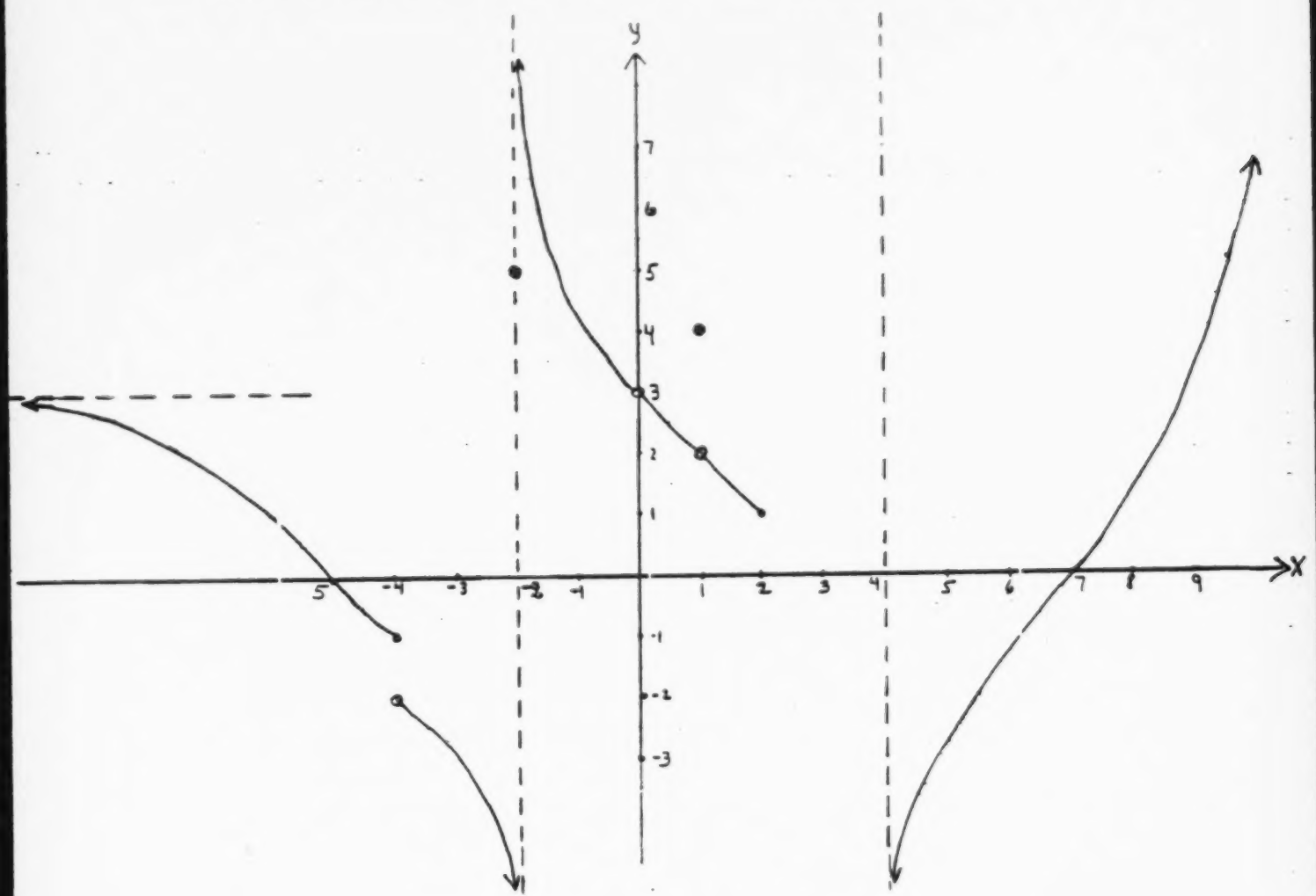
24. Suppose $(H \circ G)(x) = \left(\sqrt{x^3 - 4x}\right)^5$ and $G(x) = x^3 - 4x$ then $H(x)$ is:
    a) x^{10} b) $x^{5/2}$ c) x^5 d) $x^{2/5}$ e) none of the above

25. Suppose $(F \circ H)(x) = 3 \cos (x^4 - 3x)$ and $H(x) = x^4 - 3x$ then $(H \circ F)(x)$ is:
    a) $(3 \cos x)(x^4 - 3x)$ b) $3 \cos (x^5 - 3x^2)$ c) $81 \cos^4 x - 9 \cos x$
    d) $3 \cos x + x^4 - 3x$ e) none of the above

MATH 3022 - MODULE 3

Section 2.1 (Problems 1-18)
Section 2.2 (Problems 19-34)

Refer to the graph below of a function $y = f(x)$ for problems #1-#18.



1. $\lim_{x \to -4^-} f(x) =$

   a) -1 b) -2 c) 0 d) does not exist e) $-\infty$

2. $\lim_{x \to -4^+} f(x) =$

   a) -1 b) -2 c) 0 d) does not exist e) $-\infty$

3. $\lim_{x \to -4} f(x) =$

   a) -1 b) -2 c) 0 d) $-\infty$ e) does not exist

4. The function f(x) is discontinuous at x = -4 because:

   a) the function is not defined at x = -4 b) $\lim_{x \to -4} f(x)$ does not exist

   c) $\lim_{x \to -4} f(x)$ exists but does not equal f(-4) d) all of the above

   e) none of the above

5. $\lim_{x \to -2^-} f(x) =$

   a) 5 b) $+\infty$ c) $-\infty$ d) 0 e) none of the above

6. $\lim_{x \to -2^+} f(x) =$

   a) 5 b) $+\infty$ c) $-\infty$ d) 0 e) none of the above

7. f(x) is discontinuous at x = -2 because:

   a) f is undefined at x = -2 b) $\lim_{x \to -2} f(x)$ does not exist

   c) f(-2) exists, $\lim_{x \to -2} f(x)$ exists, but $\lim_{x \to -2} f(x) \neq f(-2)$

   d) all of the above e) none of the above

8. $\lim_{x \to 0} f(x) =$

   a) 0 b) 3 c) does not exist d) $+\infty$

9. f is discontinuous at x = 0 because:

   a) f is undefined at x = 0 b) $\lim_{x \to 0} f(x)$ does not exist

   c) f(0) exists, $\lim_{x \to 0} f(x)$ exists, but $\lim_{x \to 0} f(x) \neq f(0)$

   d) all of the above e) none of the above

10. $\lim_{x \to 1} f(x) =$

    a) 0 b) 2 c) 4 d) undefined e) none of the above

11. f is discontinuous at x = 1 because:

    a) f is undefined at x = 1 b) $\lim_{x \to 1} f(x)$ does not exist

    c) $\lim_{x \to 1} f(x)$ exists but does not equal f(1) d) all of the above

    e) none of the above

12. $\lim_{x \to 2^-} f(x) =$

    a) 0 b) 1 c) $-\infty$ d) does not exist

13. $\lim_{x \to 2^+} f(x) =$

    a) 0 b) 1 c) $-\infty$ d) does not exist

14. $\lim_{x \to 4^-} f(x) =$

a) 0 b) -1 c) $-\infty$ d) does not exist

15. $\lim_{x \to 4^+} f(x) =$

a) 0 b) -1 c) $+\infty$ d) $-\infty$

16. $\lim_{x \to 7} f(x) =$

a) 0 b) 1 c) 7 d) does not exist

17. $\lim_{x \to +\infty} f(x) =$

a) 0 b) $-\infty$ c) $+\infty$ d) none of the above

18. $\lim_{x \to -\infty} f(x) =$

a) 0 b) $+\infty$ c) $-\infty$ d) 3

For problems #19-#22, refer to the following information:

$\lim_{x \to a} f(x) = 5$, $\lim_{x \to a} g(x) = -2$

19. $\lim_{x \to a} [2 f(x) + 7] =$

a) 3 b) -4 c) 17 d) none of the above e) does not exist

20. $\lim_{x \to a} [f(x)\, g(x)] =$

a) 10 b) -10 c) 5 d) none of the above e) does not exist

21. $\lim_{x \to a} \frac{1}{f(x)} =$

a) $\frac{1}{5}$ b) $-\frac{1}{2}$ c) 5 d) none of the above e) does not exist

22. $\lim_{x \to a} \sqrt[3]{\frac{f(x)}{g(x)}} =$

a) $\sqrt[3]{\frac{5}{2}}$ b) $-\sqrt[3]{\frac{5}{2}}$ c) 1 d) none of the above e) does not exist

23. $\lim_{x \to 2} \left(\frac{x^3 + 1}{x + 1}\right) =$

a) 1 b) 2 c) 3 d) none of the above e) does not exist

24. $\lim_{x \to 1} \frac{x^4 - 1}{x - 1} =$

a) 0 b) 1 c) 4 d) $\frac{0}{0}$ e) does not exist

25. $\lim_{x \to 2} \frac{x^2 + x - 6}{x^2 - x - 2} =$

a) 1 b) $\frac{5}{3}$ c) 0 d) $\frac{0}{0}$. e) does not exist

26. $\lim_{x \to -1} \sqrt{x + 5}\ \sqrt[3]{7 - x} =$

a) 4 b) $2 \cdot \sqrt[3]{6}$ c) $\sqrt{6}\ \sqrt[3]{6}$ d) none of the above

e) does not exist

27. $\lim_{t \to 4} \frac{\sqrt{t} - 2}{t - 4} =$

a) 0 b) $\frac{1}{2}$ c) $\frac{1}{4}$ d) $\frac{0}{0}$ e) does not exist

28. $\lim_{t \to 0} [\frac{t^2 - 5t + 2}{t} - \frac{2}{t}] =$

a) 0 b) 5 c) -5 d) none of the above e) does not exist

For problems #29-#32, refer to the following function:

$$f(x) = \begin{cases} x^2 - 4 & x \leq 3 \\ x + 5 & x > 3 \end{cases}$$

29. $\lim_{x \to 3^-} f(x) =$

a) 8 b) 13 c) 5 d) 5,8 e) does not exist

30. $\lim_{x \to 3^+} f(x) =$

a) 8 b) 13 c) 5 d) 5,8 e) does not exist

31. $\lim_{x \to 3} f(x) =$

a) 8 b) 13 c) 5 d) 5,8 e) does not exist

32. $\lim_{x \to 1} f(x) =$

a) -3 b) 6 c) -3,6 d) does not exist

33. $\lim_{x \to 5^-} [\frac{|x - 5|}{x - 5} + 4] =$

a) 1 b) 5 c) 3 d) none of the above e) does not exist

34. $\lim_{x \to 5^+} [\frac{|x - 5|}{x - 5} + 4] =$

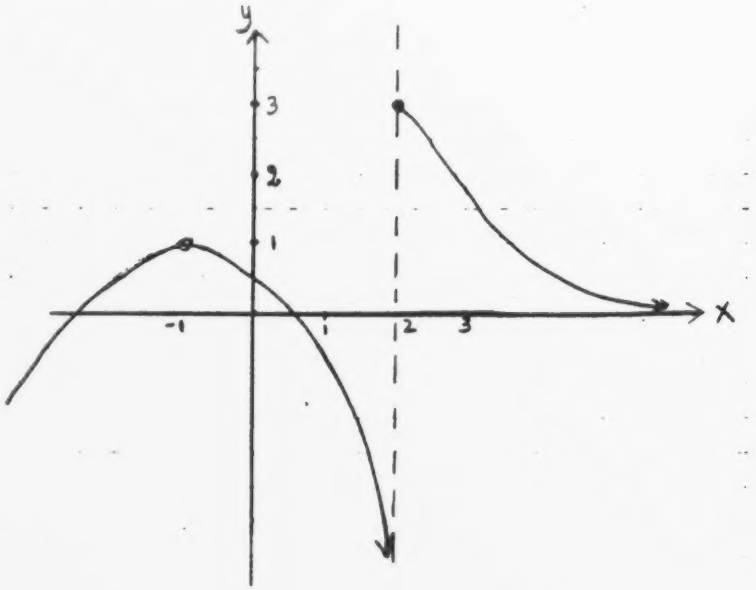
a) 1 b) 5 c) 3 d) none of the above e) does not exist

MATH 3022 - MODULE 4

Section 2.3 (Problems 1-14)
Section 2.4 (Problems 15-24)

1. Given the graph of a function f, which of the following are true statements?

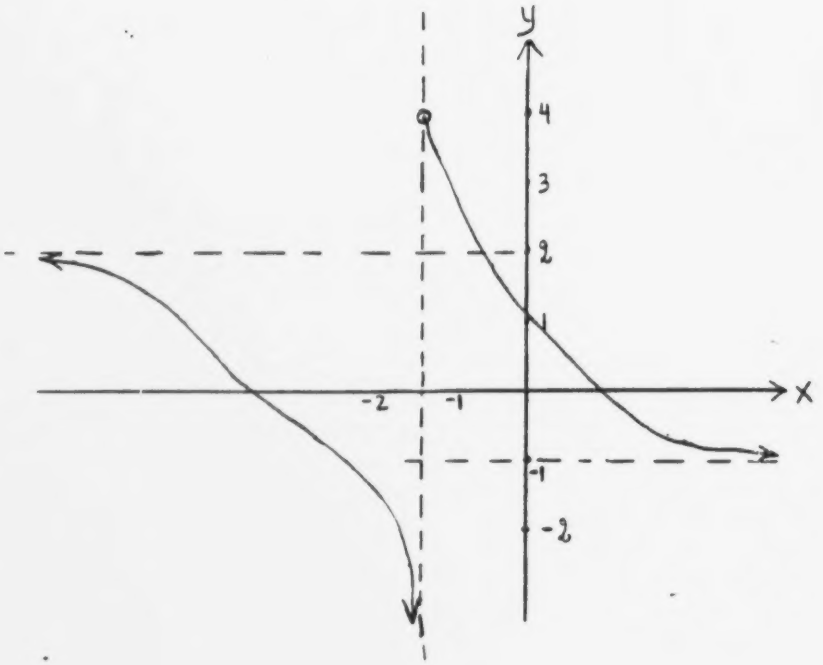
(I) $f(-1)$ does not exist
(II) $\lim_{x \to 2} f(x)$ does not exist
(III) $\lim_{x \to 2^-} f(x) = -\infty$
(IV) $\lim_{x \to 2^+} f(x) = 3$
(V) $\lim_{x \to -1} f(x) = 1$
(VI) $\lim_{x \to \infty} f(x) = 0$
(VII) $x = 2$ and $y = 0$ are asymptotes



a) I and VII only
b) II and V only
c) V, VI and VII only
d) I, II, III, IV, V, VI and VII
e) I, II, III, IV and VII only

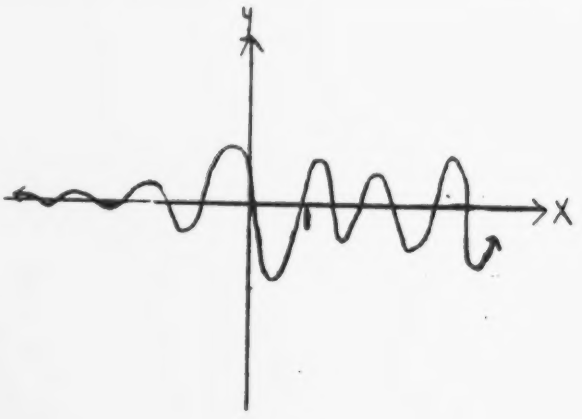
2. Given the graph of a function g, which of the following are true statements?

(I) $\lim_{x \to \infty} g(x) = -1$
(II) $\lim_{x \to -1.5^+} g(x) = 4$
(III) $\lim_{x \to -1.5^-} g(x) = -\infty$
(IV) $g(-1.5) = 4$
(V) $y = 2$, $x = -1.5$ and $y = -1$ are asymptotes
(VI) $\lim_{x \to -\infty} g(x) = 2$
(VII) $g(-1.5)$ does not exist



a) I and IV only
b) II, IV, V and VII only
c) I, II, IV, VI and VII only
d) I, III, V and VII only
e) I, II, III, V, VI and VII only

3. Given the graph of the function h, which of the following statements are true?



(I) $\lim_{x \to 1} h(x) = 0$
(II) $x = 1$ is an asymptote
(III) $\lim_{x \to \infty} h(x)$ = does not exist
(IV) $\lim_{x \to \infty} h(x) = 0$
(V) $\lim_{x \to -\infty} h(x) = 0$
(VI) $y = 0$ is an asymptote

a) I, III, V and VI only
b) I, II, V and VI only
c) I, II, III, V and VI only
d) I, IV, V and VI only
e) II, III, V and VI only

4. Given $f(x) = \dfrac{(x - 2)(x + 3)}{3x^2 - 12}$, which of the following statements are true?

(I) The horizontal asymptote is $y = 1/3$
(II) The horizontal asymptote is $y = -3/4$
(III) The vertical asymptotes are $x = 2$ and $x = -2$
(IV) The vertical asymptote is $x = -2$
(V) $\lim_{x \to \infty} f(x) = 1/3$

a) I, III and V only b) II, III and V only c) I, IV and V only
d) II and III only e) II and IV only

5. Given $g(x) = \sqrt{\dfrac{3x}{x - 2}}$, which of the following statements are true?

(I) The domain of $g = \{x \mid x \leq 0 \text{ or } x > 2\}$
(II) $\lim_{x \to 2} g(x) = \infty$
(III) $\lim_{x \to 2^+} g(x) = -\infty$
(IV) The vertical asymptote is $x = 2$
(V) The horizontal asymptote is $y = \sqrt{3}$
(VI) The horizontal asymptotes are $y = \sqrt{3}$ and $y = -\sqrt{3}$

a) I, III, IV and VI only b) I, III, IV and V only c) III, IV and V only
d) I, II, III, IV and V only e) I, II, III, IV and VI only

6. Given $h(x) = \dfrac{5x^3 + 10x + 12}{x(x + 3)}$, which of the following statements are true?

(I) The vertical asymptotes are $x = 0$ and $x = -3$
(II) The horizontal asymptote is $y = 5$
(III) The horizontal asymptote is $y = 0$
(IV) The domain of $h = \{x \mid$ all real numbers except 0 and $-3\}$
(V) The vertical asymptotes are $y = 0$ and $y = -3$
(VI) The graph has no horizontal asymptote

a) I, II and IV only b) I, IV and VI only c) I, III and IV only
d) II, IV and V only e) I, II, III and IV only

7. $\lim_{x\to\infty} \frac{3x^6 - 4x + 7}{2x^6 + 2x^3 + 2}$ is

a) $\frac{3}{2}$ b) $\frac{7}{2}$ c) does not exist d) 1 e) none of the above

8. $\lim_{x\to-\infty} \sqrt{\frac{3x^4 - 3x + 2}{4x^4 + 2x^2 - 5}}$ is

a) $-\frac{\sqrt{3}}{2}$ b) $-\sqrt{-\frac{2}{5}}$ c) $\sqrt{\frac{2}{5}}$ d) $\frac{\sqrt{3}}{2}$ e) none of the above

9. $\lim_{x\to-\infty} \frac{\sqrt{5x^2 + 2}}{4x - 1}$ is

a) does not exist b) $\frac{\sqrt{5}}{4}$ c) 2 d) -2 e) $-\frac{\sqrt{5}}{4}$

10. $\lim_{x\to-\infty} \frac{\sqrt{7x^4 + 3x + 2}}{2x^2 - 5}$

a) $\frac{2}{5}$ b) $-\frac{\sqrt{7}}{2}$ c) $\frac{\sqrt{7}}{2}$ d) $-\frac{2}{5}$ e) does not exist

11. $\lim_{x\to\infty} \frac{3x^5 - 4x^3 + 17}{5x^{10} + 2x^4 - 5}$ is

a) $\frac{3}{5}$ b) $-\frac{17}{5}$ c) does not exist d) 0 e) $-\frac{3}{5}$

12. $\lim_{x\to\infty} \frac{5x^7 + 2x^3 - 3}{2x^5 + 8}$ is

a) 1 b) $\frac{2}{5}$ c) $\frac{5}{2}$ d) $-\frac{3}{8}$ e) ∞

13. $\lim_{x\to\infty} \sqrt{2x^2 + 5x} - x$

a) $-\infty$ b) ∞ c) 0 d) $\sqrt{2}$ e) does not exist

14. $\lim_{x\to\infty} \frac{|1 - x|}{2x}$

a) 1 b) -1 c) $-\frac{1}{2}$ d) $\frac{1}{2}$ e) ∞

15. Given $f(x) = \begin{cases} x^2 + 2 & x < 1 \\ 3 & x = 1 \\ 3x & x > 1 \end{cases}$ then f is discontinuous at:

a) x = 1 only b) x = 3 only c) x = 0 d) x = -1

e) f is continuous everywhere

16. Given $h(x) = \begin{cases} x^2 + 2 & x < 2 \\ 5 & x = 2 \\ x + 3 & x > 2 \end{cases}$ then h is discontinuous at:

a) x = 2 and x = -2 only b) x = 0 and x = 2 only c) x = 2 only

d) x = -2 only e) h is continuous everywhere

17. Given $g(x) = \begin{cases} \frac{x^2 - 9}{x - 3} & \text{if } x \neq 3 \\ 10 & \text{if } x = 3 \end{cases}$ then g is discontinuous at:

a) $x = 3$ only b) $x = 3$ and $x = -3$ only c) $x = 10$ only

d) $x = 9$ only e) g is continuous everywhere

18. Given $h(x) = \begin{cases} -3x + 4 & x < -2 \\ 2x + 7 & -2 \leq x \leq 5 \\ x^2 - 8 & 5 < x \end{cases}$ then h is discontinuous at:

a) $x = -2$ and $x = 5$ only b) $x = -2$, $x = 0$ and $x = 5$ only

c) $x = 5$ only d) $x = -2$ only e) h is continuous everywhere

19. Given $g(t) = \begin{cases} t^2 + 3 & t < 0 \\ 4t - 3 & 0 \leq t < 2 \\ 3t^2 + 10 & t \geq 2 \end{cases}$ then g is discontinuous at:

a) $t = 0$ only b) $t = 2$ only c) $t = 0$ and $t = 2$ only

d) $t = 0$, $t = 2$, $t = 3$ and $t = 10$ only e) none of the above

20. Given $f(x) = \begin{cases} mx - n & x < 2 \\ 9 & x = 2 \\ nx^2 + m & x > 2 \end{cases}$ f is continuous everywhere if:

a) $m = 1$ and $n = 5$ b) $m = 5$ and $n = 1$ c) $m = 2$ and $n = 10$

d) $m = 10$ and $n = -2$ e) none of the above

21. Given $h(t) = \begin{cases} kt + 1 & t < -1 \\ \ell & t = -1 \\ 3t + 2 & t > -1 \end{cases}$ h is continuous at $t = -1$ if $(k + \ell)$ is:

a) -1 b) 0 c) 1 d) 2 e) none of the above

22. Consider the graph of a function f. Which of the following statements are true?

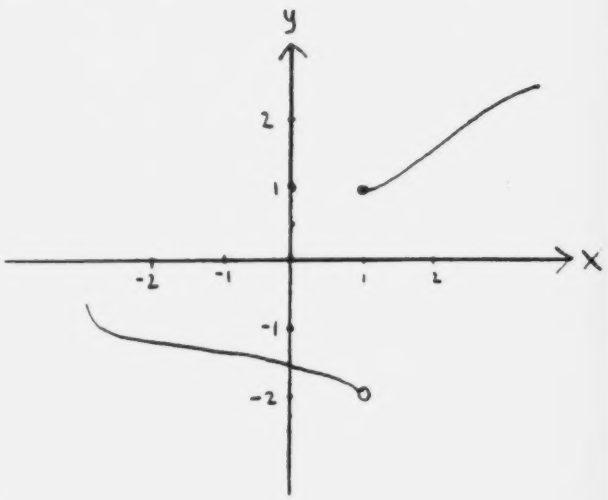
(I) $\lim_{x \to 1^-} f(x)$ does not exist

(II) $\lim_{x \to 1^-} f(x) = -2$

(III) f is discontinuous at $x = 1$ because $\lim_{x \to 1^-} f(x) \neq \lim_{x \to 1^+} f(x)$

(IV) f is discontinuous at $x = 1$ because $f(1)$ does not exist

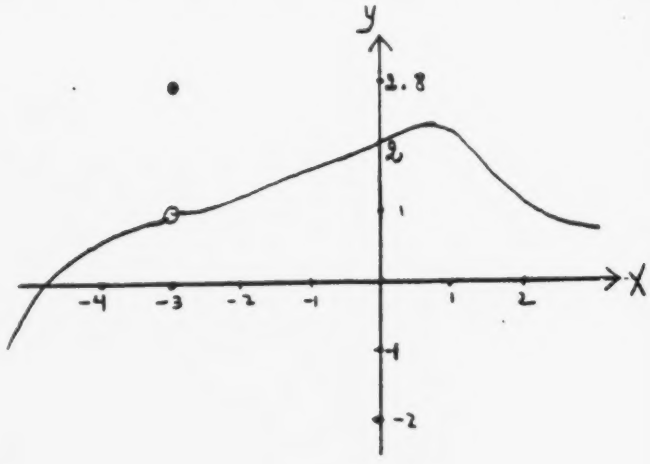
(V) f is discontinuous at $x = 1$ because $\lim_{x \to 1} f(x)$ does not exist



a) I, IV and V only
b) II, III and V only
c) I, III and V only
d) II and V only
e) none of the above

23. Consider the graph of a function f. Which of the following statements are true?

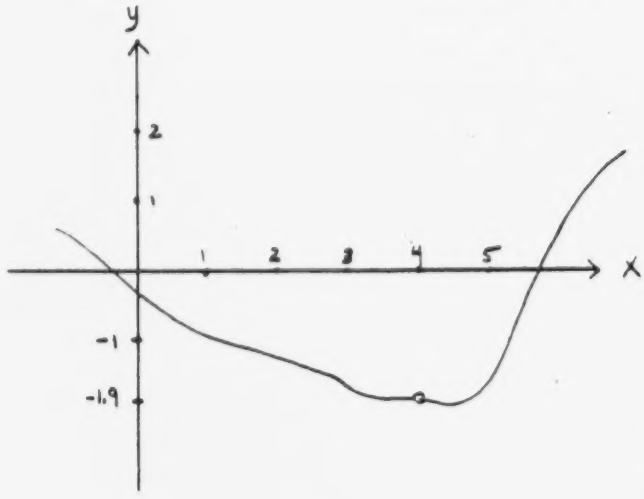
(I) $\lim_{x \to -3} f(x)$ does not exist
(II) $f(-3) = 1$
(III) $f(-3) = 2.8$
(IV) $\lim_{x \to -3} f(x) = 1$
(V) f is discontinuous at $x = -3$ because $f(-3)$ does not exist
(VI) f is discontinuous at $x = -3$ because $\lim_{x \to -3} f(x) \neq f(-3)$



a) III, IV and VI only
b) I, III and VI only
c) IV, V and VI only
d) III and VI only
e) none of the above

24. Consider the graph of a function f. Which of the following statements are true?

(I) $\lim_{x \to 4} f(x) = -1.9$
(II) $\lim_{x \to 4} f(x)$ does not exist
(III) $f(4)$ does not exist
(IV) $f(4) = -1.9$
(V) f is discontinuous at $x = 4$ because $\lim_{x \to 4} f(x)$ does not exist
(VI) f is discontinuous at $x = 4$ because $f(4)$ does not exist



a) II, III, V and VI only
b) I and III only
c) I, III and VI only
d) I only
e) I and IV only

MATH 3022 - MODULE 5

Section 3.1
Section 3.2

1. Suppose that $f(5) = 7$ and $f'(5) = 10$. The equation of the tangent line to the curve $y = f(x)$ at $x = 5$ is:

   a) $y = 10x + 7$ b) $y = 7x + 10$ c) $y = 5x + 7$ d) $y = 5x + 10$

   e) $y = 10x - 43$

2. The slope of the secant line to the graph of $f(x) = 2x^2 + 5$ from the point where $x = 1$ to the point where $x = 3$ is:

   a) 16 b) 2 c) $\frac{1}{8}$ d) 8 e) undefined

3. The slope of the secant line to the graph of $f(x) = 2x^2 + 5$ from $x = 1$ to $x = 1 + \Delta x$, $\Delta x \neq 0$ is:

   a) $2 + 2\Delta x$ b) $4 + 2\Delta x$ c) $4 + 4\Delta x$ d) 0 e) undefined

4. For $f(x) = 2x^2 + 5$, $f'(1)$ is:

   a) 4 b) 2 c) 7 d) 0 e) does not exist

5. The equation of the tangent line to the curve $f(x) = 2x^2 + 5$ at the point where $x = 1$ is:

   a) $y = 4x + 3$ b) $y = 2x + 3$ c) $y = 4x - 7$ d) $y = 7$

6. The slope of the secant line to the curve $f(x) = \frac{3}{x + 1}$ from $x = 2$ to $x = 5$ is:

   a) $-\frac{3}{2}$ b) -6 c) 6 d) $\frac{1}{6}$ e) $-\frac{1}{6}$

7. The slope of the secant line to the curve $f(x) = \frac{3}{x + 1}$ from $x = 2$ to $x = 2 + h$, $h \neq 0$ is:

   a) $\frac{1}{3 + h}$ b) $-\frac{1}{3 + h}$ c) $\frac{6 - h}{h(3 + h)}$ d) none of the above

   e) undefined

8. The slope of the tangent line to the curve $f(x) = \frac{3}{x + 1}$ at the point where $x = 2$ is:

   a) $\frac{1}{3}$ b) $-\frac{1}{3}$ c) 2 d) 0 e) undefined

9. The derivative of the function $f(x) = \frac{3}{x + 1}$ at the point where $x = 2$ is:

   a) $\frac{1}{3}$ b) $-\frac{1}{3}$ c) 2 d) 0 e) does not exist

10. The derivative of the function $y = f(x)$ at the point $x = a$ equals:

    a) $\lim_{x \to a} \frac{f(x) - f(a)}{x - a}$ b) $\lim_{\Delta x \to 0} \frac{f(a + \Delta x) - f(a)}{\Delta x}$ c) $\lim_{h \to 0} \frac{f(a + h) - f(a)}{h}$

    d) all of the above e) none of the above

11. Let $f(x) = \sqrt{x} + 2$. Then, $f'(a)$ is:

    a) $\lim_{h \to 0} \left[\frac{1}{\sqrt{a + h} + \sqrt{a}}\right]$ b) $\frac{1}{2\sqrt{a}}$ c) $\lim_{x \to a} \left[\frac{1}{\sqrt{x} + \sqrt{a}}\right]$ d) all of the above

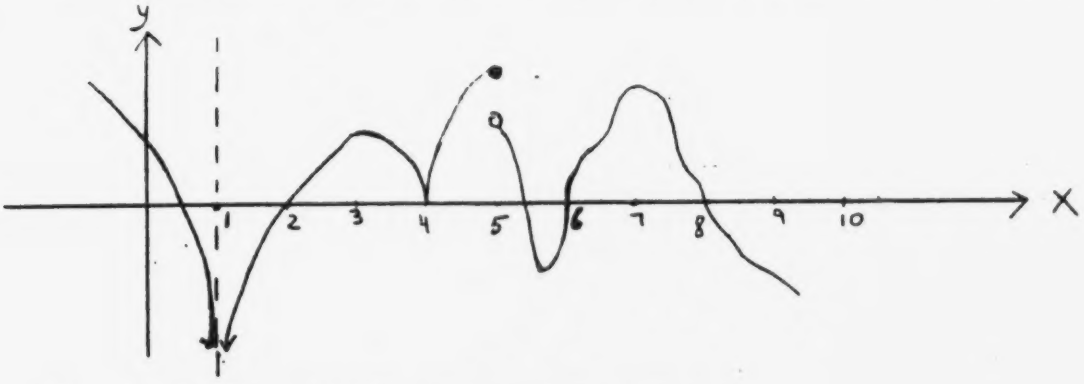
    e) none of the above

12. The derivative of the function $y = f(x)$ at $x = 4$ is denoted by:

a) $f'(4)$ b) $\left.\frac{dy}{dx}\right|_{x=4}$ c) $y'(4)$ d) all of the above

e) none of the above

Problems #13-#17 refer to the following graph of a function $y = f(x)$.



13. f is differentiable at the point where x =

a) 1 b) 2 c) 4 d) 5 e) none of the above

14. f is not differentiable at x =

a) 3 b) 6 c) 7 d) 8 e) none of the above

15. $f'(x) = 0$ when x =

a) 2 b) 3 c) 4 d) 8 e) none of the above

16. At $x = 2$, the derivative of f is:

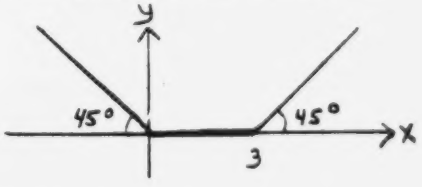
a) 0 b) undefined c) positive d) negative

17. The function f(x) is differentiable on the interval:

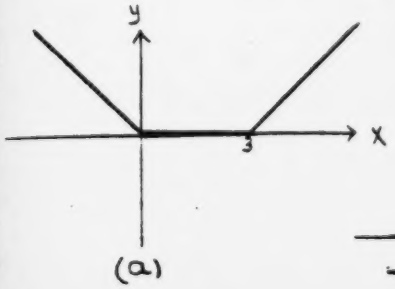
a) (1,4) b) (4,5) c) (6,∞) d) all of the above

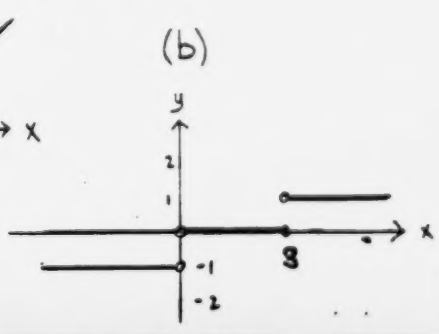
e) none of the above

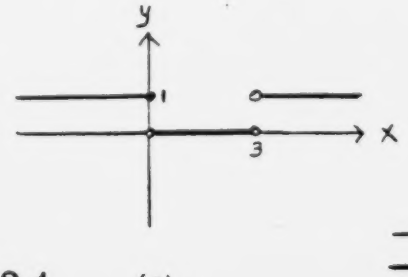
18. The function $y = f(x)$ has the graph given below:

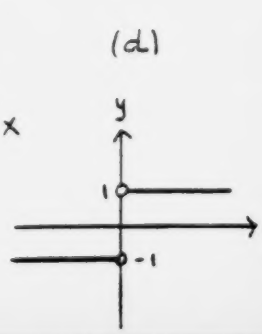


The function $f'(x)$ has the following graph:









Problems #19 and #20 refer to the following information:

A particle moves along a horizontal line according to the position function $s(t) = -t^2 + 3t$ where s is measured in feet and t in seconds.

19. The average velocity of the particle from $t = 2$ to $t = 4$ is:

a) 3 b) -6 c) -3 d) 2 e) 0

20. The instantaneous velocity of the particle at $t = 2$ seconds is:

a) -4 b) -1 c) 0 d) none of the above

MATH 3022 - MODULE 6

Section 3.3 (Problems 1-8)
Section 3.4 (Problems 9-18)
Section 3.6 (Problems 19-25)

1. If $f(x) = \frac{x}{3} + (2x)^3 + \pi$ then $f'(x) =$

   a) $x + 6x^2$ b) $\frac{1}{3} + 6x^2 + \pi$ c) $\frac{1}{3} + 24x^2$ d) $\frac{1}{3} + 24x^2 + \pi$

   e) none of the above

2. If $h(x) = \frac{4x^4 - 3x^7 + 3x^2}{x^2}$ then $h'(x) =$

   a) $8x - 15x^4$ b) $16x^3 - 21x^6 + 6x + 2x$ c) $8x^3 - 10x^6 + 6x$

   d) $16x^5 - 21x^5$ e) $\frac{16x^3 - 21x^6 + 6x}{2x}$

3. If $g(t) = 3^2t^4 - (3t)^3 + \pi^4$ then $g'(t) =$

   a) $36t^4 - 9t^2 + 4\pi^3$ b) $36t^4 - 9t^2$ c) $24t^4 - 9t^2$

   d) $36t^3 - 81t^2$ e) $36t^3 - 81t^2 + 4\pi^3$

4. If $w(x) = \frac{x^2 - 5^7}{4}$ then $w'(x) =$

   a) $\frac{2x}{0}$ b) $\frac{2x - 5^7}{4}$ c) $\frac{2x - 7(5)^6}{0}$ d) 0 e) $\frac{1}{2}x$

5. The points on the graph of $f(x) = x^3 - 7$ at which the tangent line is parallel to the line $y - 27x + 5 = 0$ is:

   a) (3,20) and (0,-7) b) (3,20) and (-3,-34) c) (3,20) and (-3,20)

   d) $(\sqrt[3]{20},13)$ and $(-\sqrt[3]{20},-27)$ e) none of the above

6. Given $f(x) = 4x^3 + 2x - 3$. The sum of the slope of the tangent line at $x = 5$ and the slope of the normal line at $x = \frac{1}{2}$ is:

   a) $3\frac{3}{4}$ b) $4\frac{1}{4}$ c) $302\frac{1}{5}$ d) $301\frac{4}{5}$ e) 302

7. The equations of the two lines passing through (-1,0) and tangent to the graph of $f(x) = x^2 + 3$ is:

   a) $y - 12 = -6(x + 3)$ and $y - 4 = 2(x - 1)$ b) $y = 2x$ and $y = 2x + 3$

   c) $y = 2x(x + 1)$ and $y = x + 1$ d) $y = -2(x + 1)$ and $y = (x + 1)$

   e) none of the above

8. Find an equation of a normal line to the graph of $f(x) = x^2 + 2x + 4$ that is parallel to the line $y = -1/6\,x - 7$

   a) $(y - 12) = -\frac{1}{6}(x - 2)$ b) $(y - \frac{817}{144}) = -\frac{1}{6}(x + \frac{13}{12})$

   c) $(y - 12) = 6(x - 2)$ d) $(y - \frac{817}{144}) = 6(x + \frac{13}{12})$ e) $y = -\frac{1}{6}(x - 2)$

9. Given $f(x) = \dfrac{5x^3 + 7x + \pi^3}{x^2 + 3x}$ then $f'(x) =$

a) $\dfrac{15x^2 + 7}{2x + 3}$ b) $\dfrac{(15x^2 + 7)(x^2 + 3x) - (5x^3 + 7x + \pi^3)(2x + 3)}{(2x + 3)^2}$

c) $\dfrac{(15x^2 + 7)(x^2 + 3x) - (5x^3 + 7x + \pi^3)(2x + 3)}{(x^2 + 3x)^2}$

d) $(15x^2 + 7)(x^2 + 3x) - (5x^3 + 7x + \pi^3)(2x + 3)$

e) $\dfrac{(15x^2 + 7 + 3\pi^2)(x^2 + 3x) - (5x^3 + 7x + \pi^3)(2x + 3)}{(x^2 + 3x)^2}$

10. Let $f(x) = (\pi x^3 - 3x)(2x^3 + 7x - 5)$ then $f'(x) =$

a) $(3\pi x^2 - 3)(6x^2 + 7)$ b) $(3\pi x^2 - 3)(2x^3 + 7x - 5) + (\pi x^3 - 3x)(6x^2 + 7)$

c) $(x^3 - 3)(2x^3 + 7x - 5) + (\pi x^3 - 3x)(6x^2 + 7)$

d) $(\pi - 3)(2x^3 + 7x - 5) + (\pi x^3 - 3x)(6x^2 + 7)$ e) $(3\pi x - 3)(5x^2 + 7)$

11. Let $h(t) = \dfrac{(4^3t^2 + 3\pi)}{(3t^3 + 7)(2t - 4)}$ then $h'(t) =$

a) $\dfrac{2t + 3}{3 \cdot 2}$ b) $\dfrac{(4^3t^2 + 3\pi)(9t^2)\cdot 2 - (3t^3 + 7)(2t - 4)2t}{(3t^3 + 7)^2(2t - 4)^2}$

c) $\dfrac{2\cdot 4^3t}{9t^2\cdot 2}$ d) $\dfrac{2\cdot 4^3t \cdot 9t^2 \cdot 2}{(3t^3 + 7)(2t - 4)^2}$

e) $\dfrac{2\cdot 4^3t\cdot(3t^3 + 7)(2t - 4) - (4^3t^2 + 3\pi)[9t^2(2t - 4) + 2(3t^3 + 7)]}{(3t^3 + 7)^2(2t - 4)^2}$

12. Let $y = (t\cdot 4 + 7t^2)(\frac{t}{2} + 3t^{10})(5t + \pi^3)$ then y'

a) $(4 + 14t)(\frac{1}{2} + 30t^9)(5)$

b) $(4 + 14t)(\frac{t}{2} + 3t^{10})(5t + \pi^3) + (t\cdot 4 + 7t^2)(30t^9)(5t + \pi^3) + (t\cdot 4 + 7t^2)(\frac{t}{2} + 3t^{10})(5 + 3\pi^2)$

c) $(4 + 14t)(\frac{t}{2} + 3t^{10})(5t + \pi^3) + (t\cdot 4 + 7t^2)(\frac{1}{2} + 30t^9)(5t + \pi^3) + (t\cdot 4 + 7t^2)(\frac{t}{2} + 3t^{10})(5)$

d) $(t + 14t)(\frac{t}{2} + 3t^{10})(5t + \pi^3) + (t\cdot 4 + 7t^2)(30t^9)(5t + \pi^3) + (t\cdot 4 + 7t^2)(\frac{t}{2} + 3t^{10}) \cdot 5$

e) $(4 + 14t)(\frac{t}{2} + 3t^{10})(5t + \pi^3) + (t\cdot 4 + 7t^2)(\frac{1}{2} + 30t^9)(5t + \pi^3) + (t\cdot 4 + 7t^2)(\frac{t}{2} + 3t^{10})(5 + 3\pi^2)$

In problem #13 and #14, use the information $f(2) = -3$, $f'(2) = 5$, $g(2) = 2$ and $g'(2) = -1$ to evaluate.

13. $\dfrac{d}{dx}[(f(x) + 10)(3g(x))]_{x=2}$

a) -45 b) -15 c) -5 d) 9 e) 69

14. $\frac{d}{dx}\left[\frac{2x - g(x)}{-1 + 2f(x)}\right]_{x=2} =$

a) $\frac{3}{10}$ b) $-\frac{41}{49}$ c) $\frac{30}{49}$ d) $\frac{27}{49}$ e) $\frac{3}{49}$

15. Let $y = \frac{x}{3} + \frac{5}{x} + \pi^3$ then $y' =$

a) $5\frac{1}{3}$ b) 0 c) $\frac{1}{3} - 5x^{-2} + 3\pi^2$ d) $\frac{1}{3} + 5 + 3\pi^2$ e) $\frac{1}{3} - \frac{5}{x^2}$

16. Let $w = \frac{3}{t^2} - \frac{t^2}{7} + \frac{\pi}{t^3}$ then $w' =$

a) $3 - \frac{1}{7} + \pi$ b) $\frac{3}{2t} - \frac{2t}{7} + \frac{\pi}{3t^2}$ c) $-\frac{6}{t^3} - \frac{2t}{7}$ d) $-\frac{6}{t} - \frac{2t}{7} - \frac{3\pi}{t^2}$

e) $-\frac{6}{t^3} - \frac{2}{7}t - \frac{3\pi}{t^4}$

17. The point(s) on the graph of $f(x) = 3x - \frac{1}{x}$ at which the slope of the tangent line is 4 are:

a) (1,2) and (-1,-2) only b) (1,2) only c) (-1,-2) only

d) $(5,14\frac{4}{5})$ only e) $(4,11\frac{3}{4})$ only

18. An equation of the tangent line to the graph of $f(x) = \frac{1}{x^2}$ at $x = \frac{1}{2}$ is:

a) $(y - 4) = 16(x - \frac{1}{2})$ b) $(y - 4) = (x - \frac{1}{2})$ c) $(y - \frac{1}{2}) = -16(x - 4)$

d) $(y - 4) = -16(x - \frac{1}{2})$ e) $y - 4 = -\frac{2}{x^3}(x - \frac{1}{2})$

19. If $y = 4 \sin x + 3^2 \cos x$ then $y' =$

a) $\cos x + 0$ b) $4 \cos x + 0$ c) $4 \cos x - 9 \sin x$

d) $4 \cos x + 9$ e) $4 \cos x + 3^2 \sin x$

20. If $y = (x^{-2} + 7) \tan x \sec x$ then $y' =$

a) $-2x^{-3} \sec^2 x \tan x$ b) $x^{-3} \sec^3 x \tan x$ c) $-2x^3 \tan \sec x$

d) $-2x^{-3} \tan x \sec x + (x^{-2} + 7) \sec^3 x \tan x$

e) $-2x^{-3} \tan x \sec x + (x^{-2} + 7) \sec^3 x + (x^{-2} + 7) \tan^2 x \sec x$

21. If $y = \frac{\csc x}{3 + \cot x}$ then $y' =$

a) $\frac{-\csc x \cot x}{3 - \csc^2 x}$ b) $\frac{-\csc x \cot x(3 + \cot x)}{(3 + \cot x)^2}$ c) $\frac{-\csc x \cot x(3 + \cot x) - \csc^2 x}{(3 + \cot x)^2}$

d) $\frac{-\csc x \cot x(3 + \cot x) + \csc^3 x}{(3 + \cot x)^2}$ e) none of the above

22. If $y = \frac{3 \sin x}{\cos x}$ then $y' =$

a) $3 \sec x \tan x$ b) $3 \sec^2 x$ c) $3 \tan x$ d) $3 \cos x \sin x$ e) $\sec^2 x$

23. An equation of the tangent line to the graph of the function $f(x) = \sin x$ at $x = \pi$ is:

a) $y - 1 = \pi - x$ b) $y - \pi = -(x - \pi)$ c) $y = -x + \pi$

d) $y = x - \pi$ e) $y - 1 = x - \pi$

24. The point(s) on the graph $f(x) = x + \sin x$ on the interval $[-2\pi, 2\pi]$ at which the tangent is horizontal are:

a) $(-\pi,-\pi)$ and (π,π) only b) $(-\pi,\pi)$ and $(-\pi,-\pi)$ only

c) $(-2\pi,-2\pi)$, $(0,0)$ and $(2\pi,2\pi)$ only d) $(-\pi,-\pi)$, $(0,0)$ and (π,π) only

e) none of the above

25. An equation of the normal line to the graph $f(x) = \tan x$ at $x = \frac{\pi}{3}$ is:

a) $y - \sqrt{3} = 4(x - \frac{\pi}{3})$ b) $y - \sqrt{3} = -\frac{1}{4}(x - \frac{\pi}{3})$ c) $y - 1.5 = -\frac{1}{4}(x + \frac{\pi}{3})$

d) $y - \sqrt{3} = 4(x + \frac{\pi}{3})$ e) $y = -\frac{1}{4}(x - \frac{\pi}{3}) - \sqrt{3}$

MATH 3022 - MODULE 7

Section 3.6 (Problems 1-18)
Section 3.7 (Problems 19-25)

1. The derivative of $y = (3x)^5 - \pi x^3$ is:

   a) $5(3x)^4 - 3\pi x^3$ b) $5\cdot 3^4 - \pi x^2$ c) $15(3x)^4 - 3\pi x^2$ d) $(15x)^4 - 3\pi x^2$

2. The derivative of $f(x) = 5(x^2 - 3x)^7$ is:

   a) $35(x^2 - 3x)^6\ 2x - 3$ b) $35(x^2 - 3x)^6$ c) $35(2x - 3)^6$

   d) $35(x^2 - 3x)^6(2x - 3)$

3. The derivative of $g(x) = \dfrac{(x - 5x^2)^3}{\pi^2}$ is:

   a) $\dfrac{3(x - 5x^2)^2(1 - 10x)\pi^2 - 2\pi(x - 5x^2)^3}{\pi^4}$ b) $\dfrac{3}{\pi^2}(x - 5x^2)^2(1 - 10x)$

   c) $\dfrac{3}{\pi^2}(x - 5x^2)^2 - 10x$ d) $\dfrac{3}{\pi^2}(x - 5x^2)^2$

4. If $y = \dfrac{(2t - 3)^4(t^2 - 5)^5}{5}$ then $dy/dt =$

   a) $4(2t - 3)^3(t^2 - 5)^4$ b) $16t(2t - 3)^3(t^2 - 5)^4$

   c) $\frac{1}{5}(2t - 3)^3(t^2 - 5)^4(4t^2 + 10t - 35)$ d) $\frac{1}{5}(2t - 3)^3(t^2 - 5)^4(28t^2 - 30t \cdot 40)$

5. If $y = \dfrac{2}{(x^3 - 3)^6}$ then $dy/dx =$

   a) $\dfrac{-36x^2}{(x^3 - 3)^7}$ b) $\dfrac{1}{6(x^3 - 3)^5}$ c) $\dfrac{-12}{(x^3 - 3)^7}$ d) $\dfrac{1}{18(x^3 - 3)^5x^2}$

6. If $y = 2(x^2 - \pi)^3(\pi x - 2)^4(x^3 - 5)^5$ then $y' =$

   a) $120(x^2 - \pi)^2(\pi x - 2)^3(x^3 - 5)^4$ b) $120(x^2 - \pi)^2 2x\cdot 4(\pi x - 2)^3\cdot\pi(x^3 - 5)^4\cdot 3x^2$

   c) $6(2x)^2(\pi x - 2)^4(x^3 - 5)^4 + 8(x^2 - \pi)^3(\pi)^4(x^3 - 5)^5 + 10(x^2 - \pi)^3(\pi x - 2)^4(3x^2)^5$

   d) $12x(x^2 - \pi)^2(\pi x - 2)^4(x^3 - 5)^5 + 8\pi(x^2 - \pi)^3(\pi x - 2)^3(x^3 - 5)^5 +$
   $30x^2(x^2 - \pi)^3(\pi x - 2)^4(x^3 - 5)^4$

7. If $y = \sin(\pi\theta - 5)$ then $dy/d\theta =$

   a) $\theta\cos(\pi\theta - 5)$ b) $\pi\cos(\pi\theta - 5)$ c) $\cos(\pi\theta - 5) + \sin\pi$

   d) $\cos(\pi\theta - 5)$

8. If $y = \dfrac{\sec(3x^2 - \pi)}{7}$ then $dy/dx =$

   a) $\frac{6x}{7}\sec\tan(3x^2 - \pi)$ b) $\frac{1}{7}\sec\tan(3x^2 - \pi)$

   c) $\frac{6x}{7}\sec(3x^2 - \pi)\tan(3x^2 - \pi)$ d) $\frac{1}{7}\sec(6x)\tan(6x)$

9. If $y = \cos^{-3}(\pi x^2 - 3\pi^2 x)$ then $dy/dx =$

a) $-3\cos^{-2}(\pi x^2 - 3\pi^2 x)$ b) $-3\cos^{-4}(\pi x^2 - 3\pi^2 x)(2\pi x - 6\pi x)$

c) $-3\cos^{-4}(\pi x^2 - 3\pi^2 x)(2\pi x - 3\pi^2)$

d) $3\cos^{-4}(\pi x^2 - 3\pi^2 x)\sin(\pi x^2 - 3\pi^2 x)(2\pi x - 3\pi^2)$

10. If $y = \csc(\tan 3x)$ then $y' =$

a) $-\csc\cdot\cot\cdot\tan 3x + \csc\cdot\sec^2 3x\cdot 3$ b) $-3\csc(\tan 3x)\cot(\tan 3x)\sec^2 3x$

c) $-3\csc(\sec^2 3x)$ d) $-\csc(\tan 3x)\cot(\tan 3x)$

11. If $y = \dfrac{(5x)^3}{\sin(3x^2 - \pi)}$ then $y' =$

a) $\dfrac{5x}{2\cos(3x^2 - \pi)}$ b) $\dfrac{15(5x)^2\sin(3x^2 - \pi) - 6x(5x)^3\cos(3x^2 - \pi)}{\sin^2(3x^2 - \pi)}$

c) $\dfrac{3(5x)^2\sin(3x^2 - \pi) - (5x)^3\cos(3x^2 - \pi)}{\sin^2(3x^2 - \pi)}$

d) $\dfrac{15x^2\sin(3x^2 - \pi) - (5x^3)\cos 6x}{\sin^2(3x^2 - \pi)}$

12. If $y = 3\{\sin^2(3x^2 - 4) + \cos(6x - 5)\}^7$ then $y' =$

a) $21\{\cos^2(3x^2 - 4) - \sin(6x - 5)\}^6$ b) $21\{\sin^2(3x^2 - 4) + \cos(6x - 5)\}^6(6x +$

c) $21\{\sin^2(3x^2 - 4) + \cos(6x - 5)\}^6\ 2\sin(3x^2 - 4)\cdot 6x - \sin(6x - 5)\}$

d) $21\{\sin^2(3x^2 - 4) + \cos(6x - 5)\}^6\{2\sin(3x^2 - 4)\cos(3x^2 - 4)\cdot 6x - \sin(6x - 5)\cdot 6\}$

13. An equation of the tangent to the graph of the function $f(x) = (x^2 + 3)^3$ at $x = -1$ is:

a) $(y - 64) = 48(x + 1)$ b) $(y - 8) = 48(x - 1)$

c) $(y - 64) = -96(x + 1)$ d) $(y - 64) = 96(x + 1)$

14. An equation of the tangent line to the graph of the function $f(x) = \sin(\pi x)$ at $x = 3/4$ is:

a) $(y - \frac{\sqrt{2}}{2}) = -\frac{\sqrt{2}\pi}{2}(x - \frac{3}{4})$ b) $(y - \frac{\sqrt{2}}{2}) = -\frac{\sqrt{2}}{2}(x - \frac{3}{4})$

c) $(y + \frac{\sqrt{2}}{2}) = -\frac{\sqrt{2}}{2}(x + \frac{3}{4})$ d) $(y - \frac{\sqrt{2}}{2}) = \frac{\sqrt{2}\pi}{2}(x - \frac{3}{4})$

15. An equation of the normal line to the graph of the function $f(x) = \cos(\frac{x}{2})$ at $x = \pi/3$ is:

a) $y - \frac{\sqrt{3}}{2} = -4(x - \frac{\pi}{3})$ b) $y - \frac{\sqrt{3}}{2} = -\frac{1}{4}(x - \frac{\pi}{3})$

c) $y - \frac{\sqrt{3}}{2} = 4(x - \frac{\pi}{3})$ d) $y - \frac{\sqrt{3}}{2} = 2(x - \frac{\pi}{3})$

16. If F is differentiable then $\frac{d}{dx}[F(4x^2 - 3)] =$

a) $F'(4x^2 - 3)\cdot 8x$ b) $F'(4x^2 - 3)$ c) $8x$ d) $F'(8x)$

17. Suppose $\frac{d}{du} f(u) = u^2 - 3$ then $\frac{d}{dx} f(-2x^2 + 5) =$

a) $2(-2x^2 + 5) - 3$ b) $(-4x)^2 - 3$ c) $[(-2x^2 + 5)^2 - 3]\cdot(-4x)$

d) $(-4x + 5)^2 - 3$

18. Suppose $\frac{d}{dx} f(x) = \frac{1}{\sqrt{1 - x^2}}$ then $\frac{d}{dx} f(x^2) =$

a) $\frac{2x}{\sqrt{1 - x^4}}$ b) $\frac{2x}{\sqrt{1 - x^2}}$ c) $-\frac{x^2}{\sqrt{(1 - x^4)^3}}$ d) $\frac{-x}{\sqrt{(1 - x^2)^3}}$

19. If $f(x) = \sin(x^2 + \pi)$ then $f''(x) =$

a) $-\sin(x^2 + \pi)$ b) $2\cos(x^2 + \pi) - 2x\sin(x^2 + \pi)$

c) $-4x\sin(x^2 + \pi)$ d) $2\cos(x^2 + \pi) - (2x)^2\sin(x^2 + \pi)$

20. If $y = \frac{3}{x} + \frac{x}{4}$ then $d^2y/dx^2 =$

a) $\frac{6}{x^3}$ b) 0 c) $-\frac{3}{x^2} + \frac{1}{4}$ d) $-\frac{6}{x^3}$

21. If $g(t) = \frac{(3t^2 - 4)^5}{5}$ then $g''(t) =$

a) $24(3t^2 - 4)^3$ b) $24(6t - 4)^3$ c) $24t(3t^2 - 4)^3 + 6(3t^2 - 4)^4$

d) $6(3t^2 - 4)^3(27t^2 - 4)$

22. If $y = \frac{3}{x^2} + \pi^7$ then $y''' =$

a) $-\frac{72}{x^5} + 210\pi^5$ b) $-\frac{72}{x^5}$ c) $\frac{72}{x^5} + 210\pi^5$ d) $\frac{9}{8}x^{-5/2}$

23. The point(s) on the graph of $f = \frac{1}{2}x^4 + x^3 - 6x^2 + 1$ at which $f''(x) = 0$ are:

a) $(1,-\frac{7}{2})$ and $(-2,-23)$ b) $(-1,-\frac{11}{2})$ and $(2,-7)$ c) $(0,1)$

d) $(1,-\frac{7}{2})$, $(-2,-23)$ and $(0,1)$

24. An equation of the tangent line to the graph of $f(x) = x^3 - 6x^2 + 3$ at the point where the value of the <u>second</u> derivative is zero is:

a) $y - 13 = 12(x + 2)$ b) $y = -13$ c) $y + 13 = -12(x - 2)$ d) $y = 3$

25. An equation of the tangent line to the graph of $f(x) = x^2 + \frac{1}{x}$ at the point where the value of the <u>second</u> derivative is -14 is:

a) $y - \frac{9}{4} = -3(x - \frac{1}{2})$ b) $y + \frac{7}{4} = -5(x + \frac{1}{2})$ c) $y - \frac{9}{4} = -14(x - \frac{1}{2})$

d) $y + \frac{7}{4} = -14(x + \frac{1}{2})$

MATH 3022 - MODULE 8

Section 3.8 (Problems 1-8)
Section 3.9 (Problems 9-21)
Section 3.10 (Problems 22-25)

1. If $y^3 - 2x^2 = \pi^3 + y$ then $dy/dx =$

a) $\dfrac{4x + 3\pi^2}{3y^2 - 1}$ b) $\dfrac{4x}{3y^2 - 1}$ c) $\dfrac{4x}{3y + 1}$ d) $\dfrac{4}{3y^2 + 1}$ e) $3y^2 - 4x$

2. If $\pi xy^2 + (x^2 + y)^3 = 5x^2$ then $dy/dx =$

a) $\dfrac{5x - 3x(x^2 + y)^2}{\pi y}$ b) $\dfrac{10x - 3(x^2 + y)^2 - \pi y^2}{2\pi xy}$

c) $\dfrac{10x - \pi y^2 - 6x(x^2 + y)^2}{2\pi xy + 3(x^2 + y)^2}$ d) $10x - 6x(x^2 + y)^2$

3. If $\sin(x^2 + y^3) = 4xy$ then $dy/dx =$

a) $\dfrac{4y - 2x\cos(x^2 + y^3)}{3y^2\cos(x^2 + y^3) - 4x}$ b) $\dfrac{\cos(2x + 3y^2) - 4y}{4x}$

c) $\dfrac{\cos(2x + 3y^2)}{4x}$ d) $\dfrac{-2x\cos(x^2 + y^3) + 4y}{3y^2 - 4x}$

4. If $\sec(xy^2) = \pi^2 + y^3$ then $dy/dx =$

a) $\dfrac{y^2\sec(xy^2)\tan(xy^2)}{3y^2 - 2xy}$ b) $\dfrac{\sec(xy^2)\tan(xy^2)(2xy)}{3y^2}$

c) $\dfrac{y^2\sec(xy^2)\tan(xy^2)}{3y^2 - 2xy\sec(xy^2)\tan(xy^2)}$ d) $\dfrac{-y^2}{2xy\sec(xy^2)\tan(xy^2) - 3y^2}$

5. An equation of the tangent line to the graph of the equation $1 + \cos y = x^3 + y - \frac{1}{2}\pi$ at $(1, \pi/2)$ is:

a) $(y - 1) = -\frac{3}{2}(x - \pi/2)$ b) $(y - \pi/2) = 2(x - 1)$

c) $(y - 1) = 2(x - \pi/2)$ d) $(y - \pi/2) = -\frac{3}{2}(x - 1)$

6. An equation of the tangent line to the graph of the equation $x^2y + y^2 = 6x$ at $(1,2)$ is:

a) $(y - 2) = 6(x - 1)$ b) $(y - 2) = \frac{2}{5}(x - 1)$

c) $(y - 2) = \frac{3}{4}(x - 1)$ d) $(y - 2) = \frac{6}{5}(x - 1)$

7. If $3 + y^3 = \pi x^4$ then the equation that represents the second derivative is:

a) $6y = 12\pi x^2$ b) $6y^2d^2y/dx^2 = 12\pi x^2$

c) $6y(dy/dx)^2 + 3y^2d^2y/dx^2 = 12\pi x^2$ d) $6y^2d^2y/dx^2 = 12x^2$

8. If $x^2 + xy^3 = 7\pi$ then the equation that represents the second derivative is:

a) $2 + 6y^2dy/dx + 6xy(dy/dx)^2 + 3xy^2d^2y/dx^2 = 0$ b) $2 + 6yd^2y/dx^2 = 0$

c) $2 + 6y^2dy/dx + 6xy(dy/dx)^2 + 3xy^2d^2y/dx^2 = 7\pi$

d) $2 + 6y^2dy/dx + 6xy\,dy/dx + 3xy^2d^2y/dx^2 = 0$

9. If $y = \frac{3}{\sqrt{x}} - \frac{\sqrt{x}}{2}$ then $dy/dx =$

a) $-6\frac{1}{\sqrt{x}} - \frac{1}{\sqrt{x}}$ b) $-\frac{3}{2}\frac{1}{\sqrt{x^3}} - \frac{1}{4}\frac{1}{\sqrt{x}}$ c) $+\frac{6}{\sqrt{x}} - \frac{1}{4}\sqrt{x}$ d) $\frac{6-x}{2\sqrt{x}}$

10. If $y = \frac{5}{\sqrt[3]{(x^2+7)^4}}$ then $dy/dx =$

a) $-\frac{20}{3}(x^2+7)^{-7/3}$ b) $\frac{5}{\sqrt[3]{(2x)^4}}$ c) $-\frac{20}{3}(x^2+7)$ d) $\frac{-40x}{3\sqrt[3]{(x^2+7)^7}}$

11. If $y = \frac{\sqrt[5]{2x^3 - 3x}}{\pi^3}$ then $dy/dx =$

a) $\frac{3(2x^2-1)}{5\pi^3\sqrt[5]{(2x^3-3x)^4}}$ b) $\frac{1}{5\pi^3\sqrt[5]{(2x^3-3x)^4}}$ c) $\frac{\sqrt[5]{(6x^2-3)^4}}{3\pi^2}$

d) $\frac{1}{5\pi^3}\frac{1}{\sqrt[5]{(6x^2-3)^4}}$

12. If $y = \tan(\sqrt[4]{x^2-5})$ then $dy/dx =$

a) $\sec^2\left(\frac{x}{2\cdot\sqrt[4]{(x^2-5)^3}}\right)$ b) $\sec^2\left(\sqrt[4]{2x-5}\right)$

c) $\frac{x}{2\sqrt[4]{(x^2-5)^3}}\cdot\sec^2\left(\sqrt[4]{x^2-5}\right)$ d) $\sec^2\left(\sqrt[4]{x^2-5}\right)$

13. If $f(x) = \sqrt{\sin 3x^2}$ then $f'(x) =$

a) $\frac{3x\cos 3x^2}{\sqrt{\sin 3x^2}}$ b) $\sqrt{\cos 3x^2}\cdot 6x$ c) $\frac{3x}{\sqrt{\cos 3x^2}}$ d) $\frac{3x\cos 3x^2}{\sqrt{\cos 3x^2}}$

14. If $h(t) = 2t^{3/2}(t^{1/2}-3)^{4.4}$ then $h'(t) =$

a) $3t^{1/2}(t^{1/2}-3)^{4.4} + 4.4t(t^{1/2}-3)^{3.4}$ b) $6.6(t^{1/2}-3)^{3.4}$

c) $3t^{1/2}(t^{1/2}-3)^{4.4} + 8.8t^{3/2}(t^{1/2}-3)^{3.4}$ d) $13.2t^{1/2}(t^{1/2}-3)^{3.4}$

15. If $y = \cos^3\sqrt[4]{x}$ then $y' =$

a) $-12\cos^{11}x\sin x$ b) $-\sin^3\sqrt[4]{x}$ c) $\frac{1}{4}\sin^3\frac{1}{\sqrt[4]{x^3}}$

d) $-\frac{3}{4\cdot\sqrt[4]{x^3}}\cos^2\left(\sqrt[4]{x}\right)\sin\left(\sqrt[4]{x}\right)$

16. If $y = (\sec x)^{2.1}$ then $y'' =$

a) $2.1(\sec^3 x\tan x)^{1.1}$ b) $(2.1)^2(\sec x)^{2.1}(\tan x)^2 + 2.1(\sec x)^{4.1}$

c) $(2.1)^2\sec^3 x$ d) $(2.1)^2(\sec x)^{1.1}\tan x + 2.1(\sec x)^{4.1}$

17. An equation of the tangent line to the graph of the function $f(x) = \sqrt[3]{\sin x}$ at $x = 3\pi/2$ is:

a) $(y+1) = \frac{1}{3}(x - 3\pi/2)$ b) $(y-1) = \frac{1}{3}(x - 3\pi/2)$ c) $y = -1$

d) $x = 3\pi/2$

18. An equation of the normal line to the graph of the function $f(x) = x^{1/4}$ at $x = 16$ is:

a) $y - 2 = 32(x - 16)$ b) $y - 2 = -\frac{1}{32}(x - 16)$ c) $y - 2 = \frac{1}{32}(x - 16)$

d) $y - 2 = -32(x - 16)$

19. If $2\sqrt{y^3} + xy = 3x^{4/3}$ then dy/dx is:

a) $4x^{1/3} - 2\sqrt{3y^2}$ b) $\frac{4x^{1/3} - y}{3\sqrt{y} + x}$ c) $\frac{4x^{1/3}}{3\sqrt{y} + 1}$ d) $4x^{1/3} - 3\sqrt{y}$

20. The graph of the function $f(x) = (x^2 - 4)^{1/3}$ has the following vertical tangent lines:

a) $x = 2$ and $x = -2$ only b) ± 2 c) $x = 2$, $x = -2$ and $x = 0$ only

d) no vertical tangent lines

21. The graph of the function $h(x) = (x^2 + 4)^{1/2}$ has the following vertical tangent lines:

a) $x = 2$ and $x = -2$ only b) $x = 0$ only c) $x = 2$, $x = -2$ and $x = 0$ only

d) no vertical tangent lines

22. If $y = \frac{3}{\sqrt[4]{x}}$ then $dy =$

a) $\frac{3}{4}\frac{1}{\sqrt[4]{x^5}}dx$ b) $-\frac{3}{4}\frac{1}{\sqrt[4]{x^5}}$ c) $\frac{3}{1/4x^{-3/4}}dx$ d) $\frac{-3}{4\sqrt[4]{x^5}}dx$

23. If $y = \sin^3(x^2)$ then $dy =$

a) $6x\sin^3(x^2)dx$ b) $\cos^3 2x\,dx$ c) $6x\sin^2(x^2)\cos(x^2)dx$ d) $3\sin^2 2x\,d$

24. If $y = x^{2/3}$, $x = 8$ and $\Delta x = -.2$ then $dy =$

a) $-\frac{2}{30}$ b) $\frac{1}{3}$ c) $-\frac{4}{30}$ d) $\frac{32}{30}$

25. If $y = 3 + \frac{8}{x}$, $x = 2$ and $\Delta x = .3$ then $dy =$

a) 3.3 b) .6 c) -2.4 d) -.6

MATH 3022 - Module 9

Section 4.1 (Problems #1-#6)
Section 4.2 (Problems #7-#20)

Problems #1 through #7 refer to the following information:

A particle moves along a horizontal line. Its position, measured in feet is given by the following equation, where t is measured in seconds: $t \geq 0$

$$s(t) = t^3 - 9t^2 + 24t + 1$$

1. The position of the particle at t = 3 seconds is:

   a) 190 b) 19 c) 0 d) -81

2. The velocity of the particle (in ft/sec) at time t seconds is given by:

   a) $t^2 - 6t + 8$ b) $3t^2 - 18t + 24$ c) $6t - 18$ d) $3t^2 + 18t - 24$

3. The acceleration (in ft/sec^2) of the particle at time t seconds is given by:

   a) $6t - 18$ b) $6t + 18$ c) $t^2 - 6t + 8$ d) 6

4. The velocity of the particle is zero, when t equals:

   a) 2 only b) 4 only c) 0 only d) 2 and 4 only

5. Which of the following is true?

   a) the particle moves to the right for $2 < t < 4$ and to the left for $0 < t < 2$ and $t > 4$

   b) the particle moves to the right for $0 < t < 2$ and to the left for $t > 2$

   c) the particle moves to the left for $0 < t < 4$ and to the right for $t > 4$

   d) the particle moves to the left for $2 < t < 4$ and to the right for $0 < t < 2$ and $t > 4$

6. Which of the following is true?

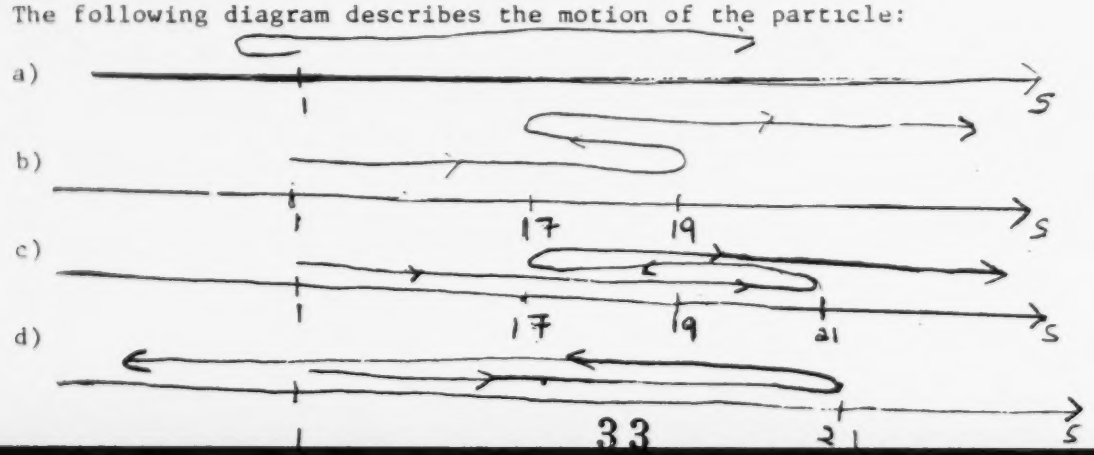
   a) the particle speeds up when $2 < t < 3$ and $t > 4$ and slows down when $0 < t < 2$ and $3 < t < 4$

   b) the particle slows down when $2 < t < 3$ and $t > 4$ and speeds up when $0 < t < 2$ and $3 < t < 4$

   c) the particle slows down when $t < 3$ and speeds up when $t > 3$

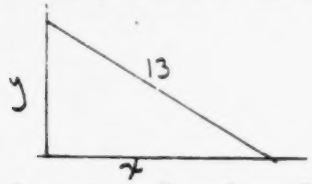
   d) the particle slows down when $t > 3$ and speeds up when $t < 3$

7. The following diagram describes the motion of the particle:



Problems #8 through #10 refer to the following:

A 13 foot ladder is leaning against a wall and its top is slipping down the wall at the rate of 3 ft/sec when it is 5 ft from the ground. Let x and y (in ft) be functions of t (sec) as picture here.



8. x and y are related as follows:

a) $x + y = 13$ b) $x^2 + y^2 = 13$ c) $x^2 + 25 = 169$ d) $x^2 + y^2 = 169$

9. At any time t, the rate at which the foot of the ladder is moving along the ground is given (in ft/sec) by:

a) $-\frac{x}{y}\frac{dx}{dt}$ b) $-\frac{y}{x}\frac{dy}{dt}$ c) $-\frac{3y}{x}$ d) $\frac{3y}{x}$

10. At the instant when the top of the ladder is 5 ft from the ground, the foot of the ladder is moving away from the wall at a rate (in ft/sec) of:

a) 3 b) $\frac{5}{12}$ c) $\frac{5}{4}$ d) $\frac{15}{4}$

Problems #11 through #13 refer to the following:

A spherical balloon is being inflated so that its volume is increasing by 100 cm^3/sec.

Let r (in cm) be the radius of the balloon at time t (sec).
Let V (in cm^3) be the volume of the balloon at time t (sec).

11. Which of the following is true?

a) $V = \frac{4}{3}\pi r^3$ and $\frac{dv}{dt} = 4\pi r^2$ b) $V = \frac{4}{3}\pi r^3$ and $\frac{dv}{dt} = 4\pi r^2\frac{dr}{dt}$

c) $100 = \frac{4}{3}\pi r^3$ and $4\pi r^2\frac{dr}{dt} = 0$ d) $V = \pi r^2$ and $\frac{dv}{dt} = 2\pi r\frac{dr}{dt}$

e) $V = \pi r^2$ and $\frac{dv}{dt} = 2\pi r$

12. The rate at which the radius is increasing at any time t is given (in cm/sec) by:

a) $\frac{100}{\pi r^2}$ b) $\frac{100}{\pi}$ c) $\frac{50}{\pi r}$ d) $\frac{25}{\pi r^2}$

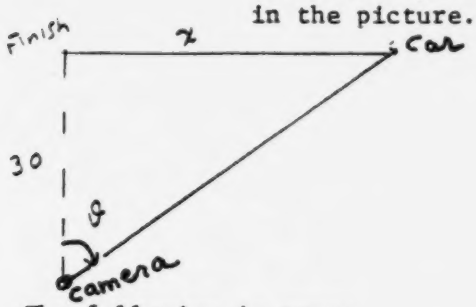
13. When the radius is 9 cm, it is increasing at the rate of (in cm/sec):

a) $\frac{100}{81\pi}$ b) $\frac{25}{81\pi}$ c) 972π d) 100

Problems #14 through #16 refer to the following:

A television camera is 30 m directly opposite the finish line at an automobile racetrack and is trained on the lead car as it approaches the finish, as pictured below.

Let x (in m) and θ (in radians) be as in the picture.



14. The following is true:

a) $\sin\theta = \frac{x}{30}$ and $\frac{d\theta}{dt} = \frac{1}{30}$ b) $\tan\theta = \frac{x}{30}$ and $\sec^2\theta \frac{d\theta}{dt} = \frac{1}{30}$

c) $\tan\theta = \frac{x}{30}$ and $\sec^2\theta = \frac{1}{30}$ d) $\tan\theta = \frac{x}{30}$ and $\sec^2\theta \frac{d\theta}{dt} = \frac{1}{30}\frac{dx}{dt}$

e) $x^2 + 900 = \theta^2$ and $2x\frac{dx}{dt} = 2\theta\frac{d\theta}{dt}$

15. The rate at which the camera is turning (in radians/sec) at time t (sec) is:

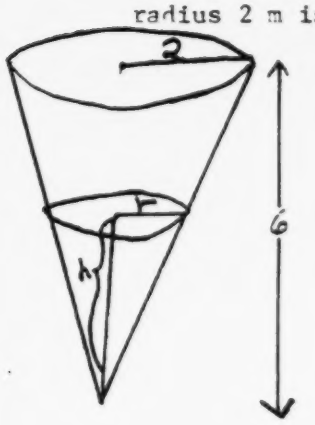
a) $\frac{1}{30\sec^2\theta}$ b) $\frac{1}{30}\frac{dx}{dt}$ c) $\frac{\cos^2\theta}{30}\frac{dx}{dt}$ d) $\frac{1}{30\cos\theta}\frac{dx}{dt}$

16. If the car is travelling at the rate of 150 km/hr, the rate (in rad/sec) at which the camera is turning when the car is 40 m from the finish line is:

a) $-\frac{1}{2}$ b) $-\frac{9}{5}$ c) -5 d) $-\frac{9}{150}$

Problems #17 through #20 refer to the following:

A water tank in the shape of an inverted cone with height 6 m and top radius 2 m is being filled with water at the constant rate of .5 m^3/min.



Let r and h be the radius and height (in m), respectively, of the water, as pictured below at time t (min) and

Let V (in m^3/min) be the volume of the water in the tank at time t (min).

17. r and h are related as follows:

a) $h = 6r$ b) $h = 3r$ c) $r = 2h$ d) $r = 3h$

18. The following is true:

a) $V = \frac{1}{27}\pi h^3$ and $\frac{dh}{dt} = \frac{9}{2\pi h^2}$ b) $V = \frac{1}{27}\pi h^3$ and $\frac{dh}{dt} = \frac{1}{18\pi h^2}$

c) $V = \frac{1\pi h^3}{3}$ and $\frac{dh}{dt} = \frac{1}{2\pi h^2}$ d) $V = \frac{1}{3}\pi h^2$ and $\frac{dh}{dt} = .5$

e) $V = \frac{1}{27}\pi h^3$ and $\frac{dV}{dt} = \frac{1}{9}\pi h^2$

19. The rate at which the water level is rising when the water level is 3 m is given (in m/min) by:

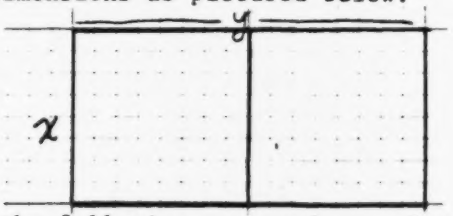
a) $\frac{9}{2\pi}$ b) $\frac{1}{243\pi}$ c) $\frac{9}{8\pi}$ d) $\frac{1}{2\pi}$

20. The rate at which the water level is rising when the tank is half full is given (in m/min) by:

a) $\frac{9}{8\pi}$ b) 2π c) $\frac{1}{4\pi\sqrt[3]{2}}$ d) $\frac{1}{2\pi}$

Questions 1 - 4 refer to the following:

A farmer has 60 feet of fence to construct two adjacent rectangular pig pens with equal dimensions as pictured below.



1. Which of the following expressions relating x and y is true?

   a) $xy = 60$
   b) $2x + 2y = 60$
   c) $3x + 2y = 60$
   d) $x + y = 60$
   e) none of the above

2. The possible values that the variable x can take is

   a) $x \geq 0$
   b) $0 \leq x \leq 30$
   c) $0 \leq x \leq 60$
   d) $0 \leq x \leq 20$
   e) all real numbers

3. The total area of both pig pens is given by

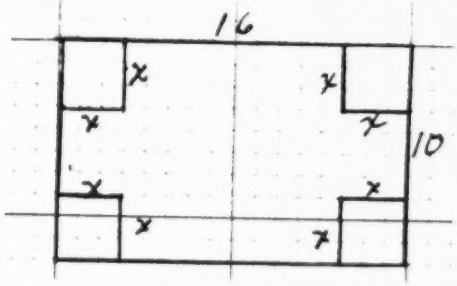
   a) $A(x) = 30x - \frac{3}{2}x^2$
   b) $A(x) = x(60 - x)$
   c) $A(x) = 3x + \frac{120}{x}$
   d) $A(x) = x(30 - x)$
   e) none of the above

4. The dimensions of the pig pen yielding the longest area is

   a) $x = 10$, $y = 50$
   b) $x = 10$, $y = 15$
   c) $x = 10$, $y = 6$
   d) $x = 15$, $y = 10$
   e) none of the above

Questions 5 - 7 refer to the following:

A box with no top is to be made from a rectangular sheet of cardboard 10 cm wide and 16 cm long by cutting equal squares from four corners and folding up the sides as pictured below.



5. The variable x may take values

a) $0 \leq x \leq 10$
b) $0 \leq x \leq 16$
c) $0 \leq x \leq 5$
d) $0 \leq x \leq 8$
e) none of the above

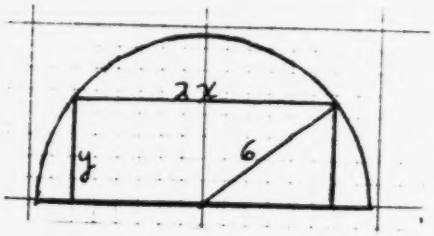
6) Volume of the box is given by the function

a) $V(x) = x(10 - x)\ (16 - x)$
b) $V(x) = x(10 - 2x)\ (16 - 2x)$
c) $V(x) = (10 - x)\ (16 - x)$
d) $V(x) = 160x$
e) none of the above

7) The value of x yielding the box with the longest volume is

a) $x = 2$
b) $x = 1$
c) $x = 5$
d) $x = 3$
e) none of the above

Questions 8 - 11 refer to the following picture



Consider the rectangle inscribed in the semi-circle of radius 6 as pictured here.

8. The variable x may take the following values

a) $0 \leq x \leq 3$
b) $0 \leq x \leq 6$
c) $0 \leq x \leq 36$
d) any positive real number
e) none of the above

9. Which of the expressions relating x and y is true?

a) $y = 6 - x$
b) $x^2 + y^2 = 36$
c) $x + y = 6$
d) $v = -\sqrt{36 - x^2}$
e) none of the above

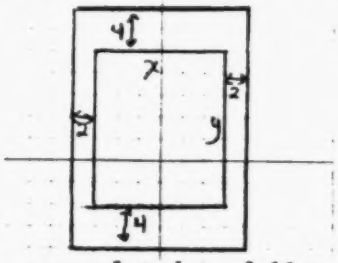
10. The area of the inscribed rectangle is given by the following expression

a) $A(x) = x\sqrt{36 - x^2}$
b) $A(x) = 2x\sqrt{36 - x^2}$
c) $A(x) = (2x)(6)$
d) $A(x) = xy$
e) none of the above

11. The dimensions of the inscribed rectangle with the largest possible area are

a) $3\sqrt{2} \times 3\sqrt{2}$
b) $6\sqrt{2} \times 6\sqrt{2}$
c) 3×6
d) $3\sqrt{2} \times 6\sqrt{2}$
e) none of the above

Questions 12 - 16 refer to the following:
A printer is to use a page with 4 cm margins at top and bottom, and 2 cm margins on the left and right sides. The rectangular region of printed matter is to have an area of 800 cm^2.



12. The variables x and y are related as follows

a) $x + y = 800$
b) $2x + 2y = 800$
c) $xy = 8$
d) $xy = 800$
e) none of the above

13. The variable x may take the following values

a) $x \geq 0$
b) $x > 0$
c) $0 < x < 800$
d) $0 \leq x \leq 800$
e) none of the above

14. The area of the whole page is given by

a) $A = 800$
b) $A = xy$
c) $A = (x + 4)(y + 4)$
d) $A = (x + 4)(y + 8)$
e) none of the above

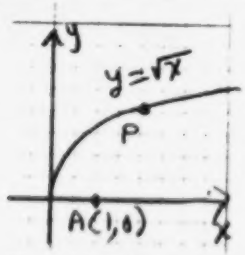
15. The area of the whole page is given by

a) $A(x) = 800 + 8x + 3200x^{-1}$
b) $A(x) = x(800x^{-1})$
c) $A(x) = (x + 4)\left(\frac{800}{x} + 8\right)$
d) $A(x) = x(x + 4)$
e) none of the above

16. The dimensions of the whole page which will have the smallest area are

a) 24 cm x 48 cm
b) 20 cm x 40 cm
c) $20\sqrt{2}$ cm x $20\sqrt{2}$ cm
d) 30 cm x 30 cm
e) none of the above

Questions 17 - 19 refer to the following.
Consider the function $y = \sqrt{x}$ and the point A, (1, 0)



Let P $(x, \sqrt{x})$ be any point on the graph.

17. The distance between P and A is given by

a) $D(x) = \sqrt{x^2 + x + 1}$
b) $D(x) = \sqrt{x^2 - 2x + 1}$
c) $D(x) = \sqrt{x^2 - x + 1}$
d) $D(x) = x^2 - x + 1$
e) None of the above

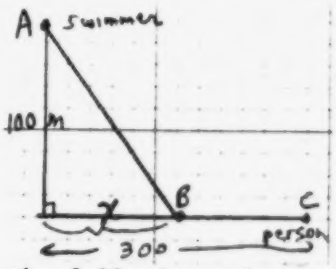
18. The point P is closest to the point A when

a) $x = 0$
b) $x = 1$
c) $x = 3$
d) $x = \frac{1}{2}$
e) None of the above

19. The point P is farthest from the point A when

a) $x = 0$
b) $x = 1$
c) $x = 3$
d) $x = \frac{1}{2}$
e. None of the above

A swimmer is in the ocean 100 meters from a straight shore line. A person in distress is located on the shore line 300 meters from the point on the shore line closest to the swimmer. The swimmer can swim 3 meters per second and run 5 meters per second.



20. The variable x can take the following values

a) $x \leq x \leq 300$
b) $0 \leq x \leq 100$
c) $x \geq 0$
d) all real numbers
e) none of the above

21. The variables x and y are related as follows

a) $x + y = 100$
b) $x - y = 100$
c) $y = \sqrt{x^2 + 1000}$
d) $y = \sqrt{1000 - x^2}$
e) none of the above

22. The time it will take for the man to swim from point A to point B and then run from B to C is

a) $T(x) = \sqrt{100 + x^2} + (300 - x)$
b) $T(x) = \frac{1}{5}\sqrt{100 + x^2} + \frac{1}{3}(300 - x)$
c) $T(x) = \frac{1}{3}\sqrt{x + 100} + \frac{1}{5}(300 - x)$
d) $T(x) = \frac{1}{3}\sqrt{1000 + x^2} + \frac{1}{5}(300 - x)$
e) None of the above

23. To minimize the time of the above trip the value for x should be

a) 75
b) 225
c) 0
d) 300
e) none of the above

Questions 1 - 11 refer to the following information.

Let $f(x) = x^4 - 2x^3 - 9x^2 + 27$

1. The critical values of f(x) are

a) $x = 3$ and $x = \frac{-3}{2}$ only

b) $x = 0$, $x = \frac{-3}{2}$, and $x = 3$ only

c) $x = 0$, $x = \frac{3}{2}$ and $x = -3$ only

d) $x = \frac{3}{2}$ and $x = -3$ only

e) none of the above

2. The relative maximum of f(x) occur when

a) $x = 3$ and $x = \frac{-3}{2}$ only

b) $x = 5$ only

c) $x = 0$ and $x = 5$ only

d) $x = 0$ only

e) none of the above

3. The relative minima of f(x) occur when

a) $x = 3$ and $x = \frac{-3}{2}$ only

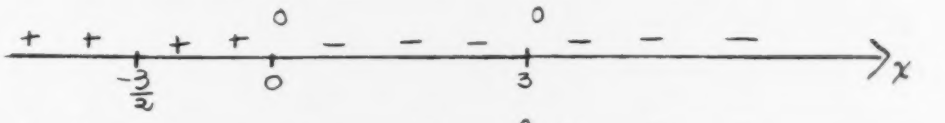
b) $x = \frac{3}{2}$ and $x = -3$ only

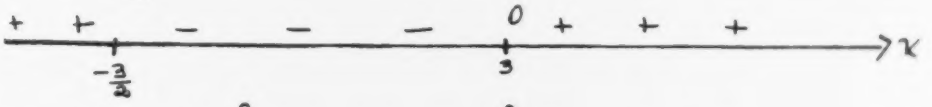
c) $x = 3$ only

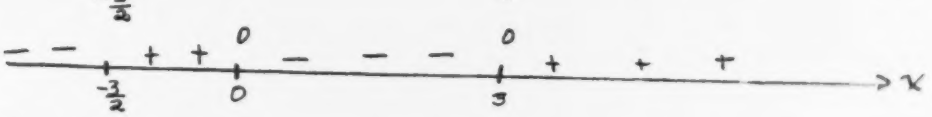
d) $x = \frac{-3}{2}$ only

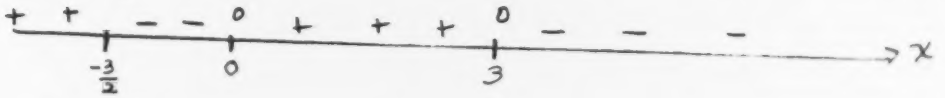
e) none of the above

4. The following number line describes the sign of $f'(x)$

a) 

b) 

c) 

d) 

e) none of the above

5. The graph of f is increasing on the intervals

a) $(\frac{-3}{2}, 0) \cup (3,\infty)$

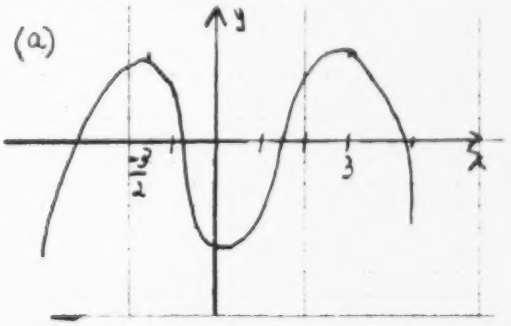
b) $\frac{-3}{2} \leq x < \infty$

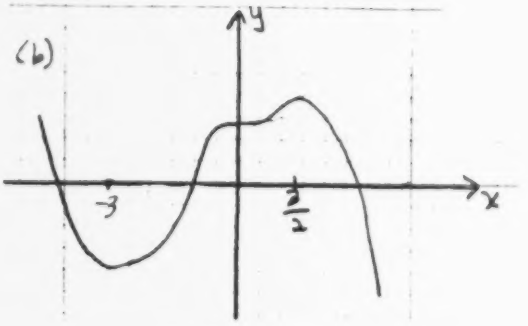
c) all real numbers

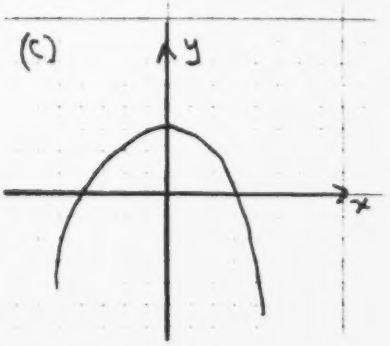
d) $(-\infty, \frac{-3}{2}) \cup (0,3)$

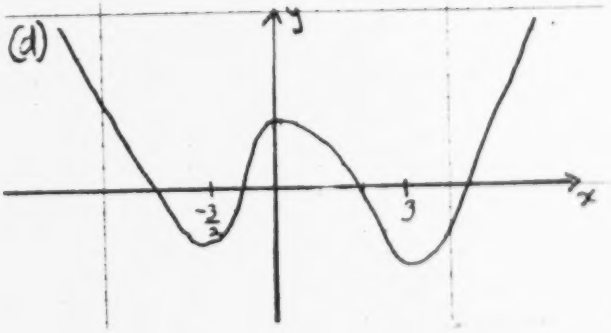
e) none of the above

6. A sketch of f(x) is

(a) 

(b) 

(c) 

(d) 

e) none of the above

7. The absolute maximum of f(x) on [-2, 5] occurs when

a) x = 0 only
b) x = 5 only
c) x = 0 and x = 5 only
d) x = 1 only
e) none of the above

8. The absolute minimum of f(x) on [-2, 5] occurs when

a) x = -2 only
b) x = 3 and x = $\frac{-3}{2}$ only
c) x = 3 only
d) x = 0 only
e) none of the above

9) The absolute maximum of f(x) on [-2, 5] is

a) 5
b) 27
c) 177
d) 200
e) none of the above

10) The absolute minimum of f(x) on [-2, 5] is

a) -27
b) 27
c) 0
d) -100
e) none of the above

11. Which of the following is true?

a) f has an absolute maximum and an absolute minimum on $(-\infty, \infty)$

b) f has an absolute maximum but no absolute minimum on $(-\infty, \infty)$

c) f has an absolute minimum but has no absolute maximum on $(-\infty, \infty)$

d) f has neither an absolute maximum nor an absolute minimum on $(-\infty, \infty)$

e) There is not enough information to determine whether or not f has any extrema on $(-\infty, \infty)$.

Questions 12 - 28 refer to the following:

$$g(x) = 8x^{\frac{1}{3}} - 2x^{\frac{4}{3}}$$

12. $g'(x) =$

a) $(8/6)\left[\frac{1 + x}{x^{2/3}}\right]$

b) $(-8/3)x^{-1/3}$

c) $(8/3)\left[\frac{1 - x}{x^{2/3}}\right]$

d) $(8/3)\left[\frac{1}{x^{2/3}}\right]$

e) none of the above

13. $g''(x) =$

a) $(-8/6)\left[\frac{x + 2}{x^{5/3}}\right]$

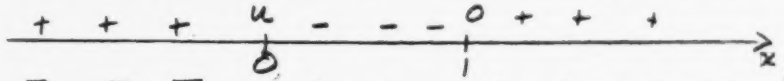
b) $\frac{-16}{9}\left[x^{-7/3}\right]$

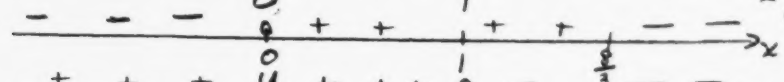
c) $(-8/9)\left[\frac{2 + x}{x^{5/3}}\right]$

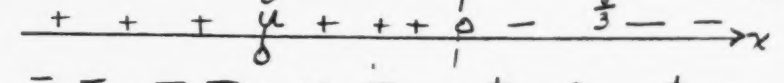
d) $(-16/9)\left[\frac{1}{x^{2/3}}\right]$

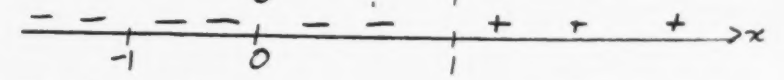
e) none of the above

14. The following number line describes the sign of g'(x)

a) 

b) 

c) 

d) 

(Where U stands for undefined)

e) none of the above

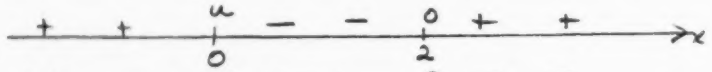
15. The graph of g is increasing on the intervals

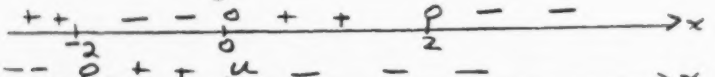
a) $x \geq 0$
b) $(-\infty, 0) \cup (0, 1)$
c) $x \leq 1$
d) $(-\infty, -1) \cup (0, \infty)$
e) none of the above

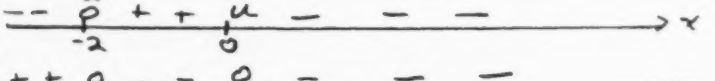
16. The graph of g is decreasing on the intervals

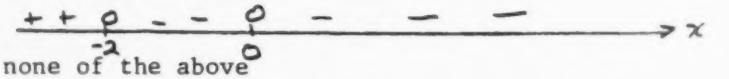
a) $(-1, 0)$
b) $(-\infty, 0)$
c) $(1, \infty)$
d) $(-\infty, 1)$
e) none of the above

17. The following number line describes the sign of g''(x)

a) 

b) 

c) 

d) 

(Where U stands for undefined)

e) none of the above

18. The function g(x) has critical values at

a) x = 1 only
b) x = 0 and x = +1 only
c) x = 0 only
d) x = -1 and x = 0 only
e) none of the above

19. The function of g(x) has relative maxima at

a) x = 1 only
b) x = 0 and x = 1 only
c) x = 0 only
d) x = -1 and x = 0 only
e) none of the above

20. The function g(x) has relative minima at

a) x = 1 only
b) x = 0 and x = 1 only
c) x = 0 only
d) x = -1 and x = 0
e) none of the above

21. The function g(x) has an inflection point(s) at

a) x = -2 only
b) x = 0 only
c) x = -2 and x = 0 only
d) x = 1 only
e) none of the above

22. On the interval [-1, 8], g(x) has an absolute maximum at

a) x = 8 only
b) x = 1 only
c) x = 0 only
d) x = 0 and x = 1 only
e) none of the above

23. The absolute maximum of g(x) on [-1, 8] is

a) 16
b) -16
c) 0
d) 6
e) none of the above

24. On the interval [-1, 8], g(x) has an absolute minimum at

a) x = -1 only
b) x = -2 only
c) x = 0 only
d) x = 8 only
e) none of the above

25. The absolute minimum of g(x) on [-1, 8] is

a) -16
b) -100
c) -10
d) 0
e) -48

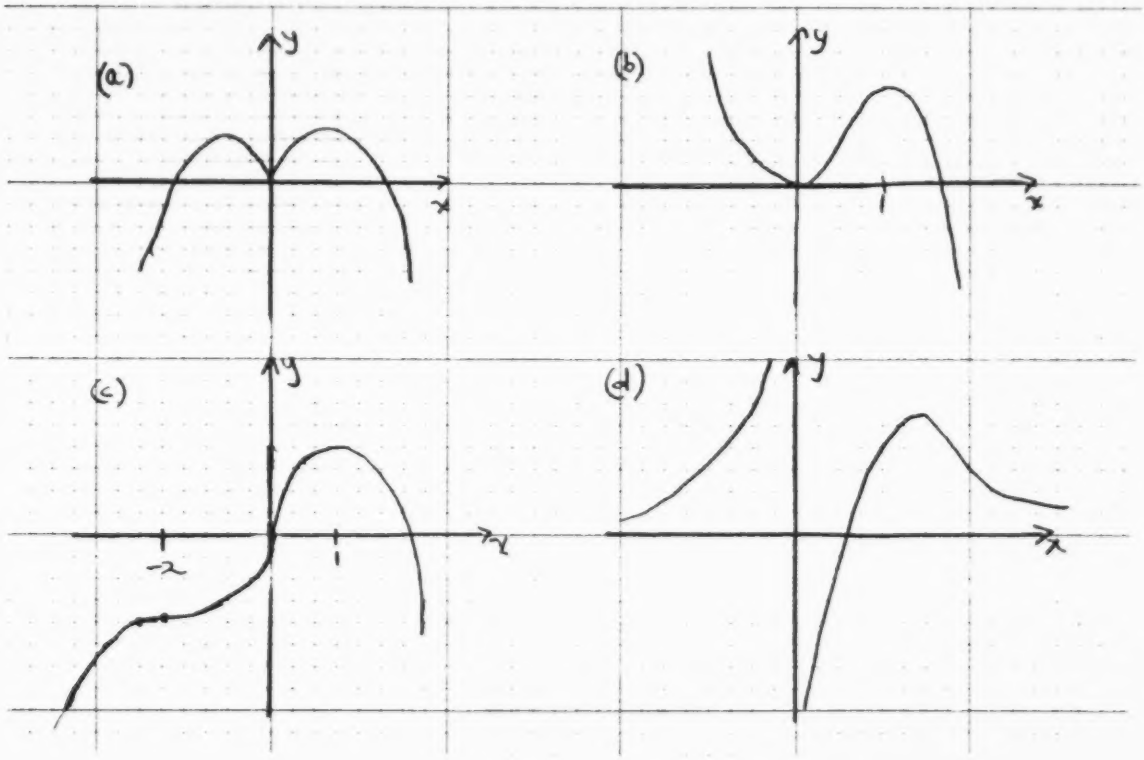
26. The function g(x) has horizontal tangent(s) at

a) x = 1 only
b) x = 0 and x = 1 only
c) c = 0 only
d) x = -2 only
e) none of the above

27. The function g(x) has vertical tangent(s) at

a) x = 1 only
b) x = 0 and x = 1 only
c) x = 0 only
d) x = -2 only
e) none of the above

28. The graph of g(x) might look like this



e) none of the above

Problems 29 - 42 refer to the following

Let $h(x) = \frac{6 - 6x}{x^2}$

29. $h'(x) =$

a) $\frac{3}{x}$

b) $\frac{6}{x^2}$

c) $\frac{6(x + 2)}{x^3}$

d) $\frac{6(x - 2)}{x^3}$

e) none of the above

30. $h''(x) =$

a) $\frac{12(x - 3)}{x^4}$

b) $\frac{12(2x + 3)}{x^4}$

c) $\frac{12(3 - x)}{x^4}$

d) $\frac{24}{x^3}$

e) none of the above

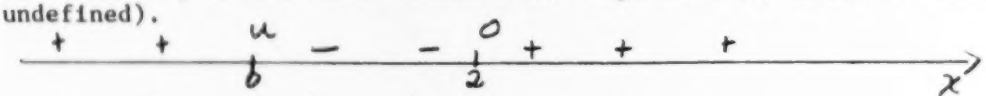
31. The graph of h(x) has vertical asymptote(s) at

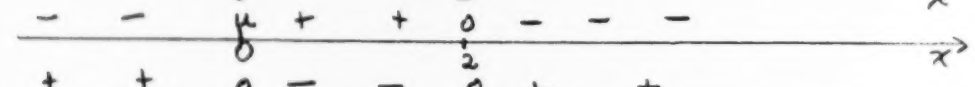
a) x = 2 only
b) x = 0 only
c) x = 2 and -2 only
d) x = 3 only
e) no vertical asymptotes

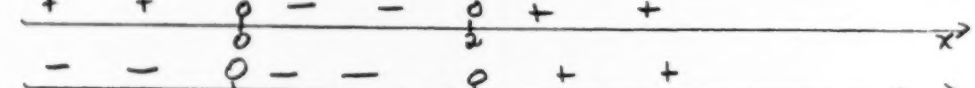
32. The graph of h(x) has horizontal asymptote(s) at

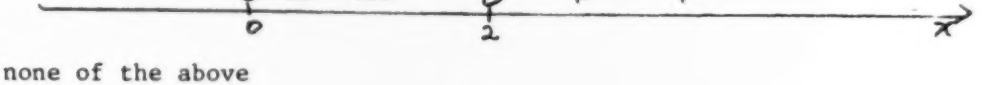
a) y = 0 only
b) y = 6 only
c) y = 6 and y = -6 only
d) y = -1 only
e) no horizontal asymptotes

33. The following number line describes the sign of h'(x) (where U stands for undefined).

a) 

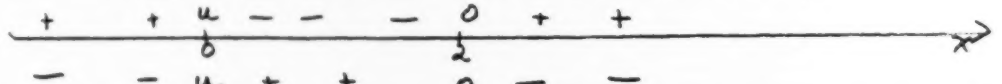
b) 

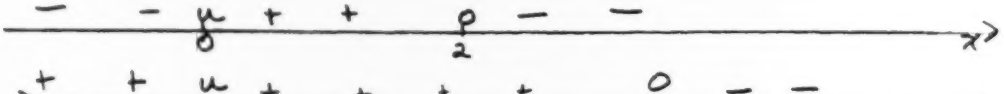
c) 

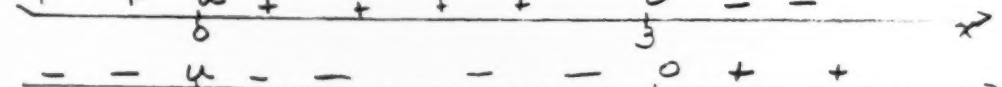
d) 

e) none of the above

34. The following number line describes the behavior of h''(x)

a) 

b) 

c) 

d)

e) none of the above

35. The function h(x) is increasing when

a) $x > 2$ only
b) $x < 0$ or $x > 3$ only
c) $2 < x < 3$ only
d) $x < 0$ or $x > 2$ only
e) none of the above

36. The function h(x) is decreasing when

a) $0 < x < 2$ only
b) $x < 0$ or $x > 2$ only
c) $x < 2$ only
d) $x > 2$ only
e) none of the above

37. The function h(x) has a relative maximum at

a) x = 0 only
b) x = 2 only
c) x = 0 and x = 2 only
d) x = 3 Only
e) none of the above

38. The function h(x) has a relative minimum at

a) x = 0 only
b) x = 2 only
c) x = 0 and x = 2 only
d) x = 3 only
e) none of the above

39. The function h(x) has an inflection point at

a) x = 0 only
b) x = 0 and x = 3 only
c) x = 2 only
d) x = 3 only
e) none of the above

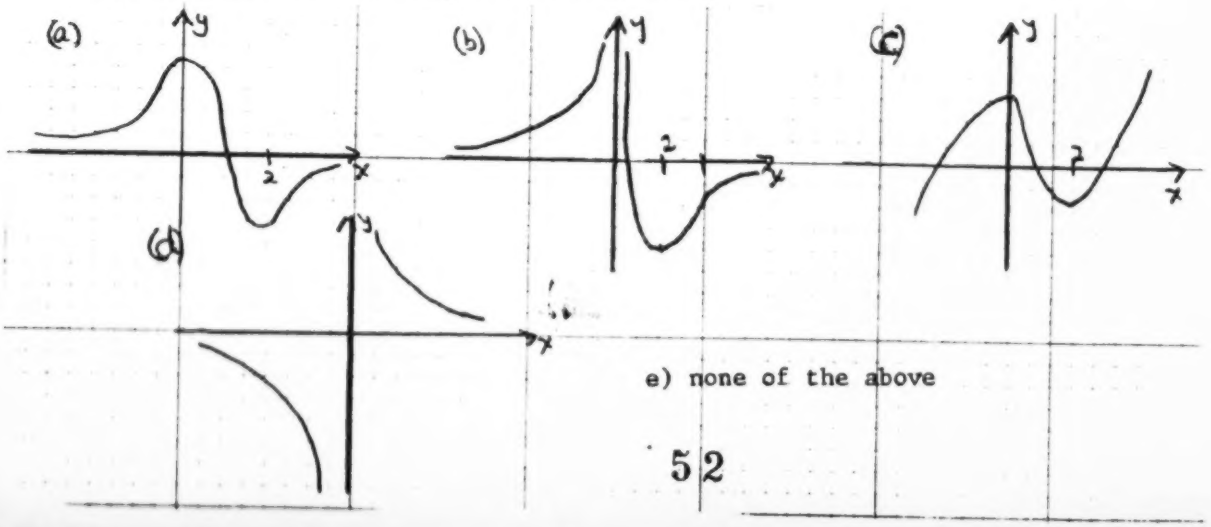
40. The graph of the function h(x) is concave up when

a) $x < 2$ or $x > 3$ only
b) $x > 3$ only
c) $x < 0$ or $0 < x < 3$ only
d) $x < 3$ only
e) none of the above

41. The graph of h(x) is concave down when

a) $x < 2$ or $x > 3$ only
b) $x > 3$ only
c) $x < 0$ or $0 < x < 3$ only
d) $x < 2$ only
e) none of the above

42. The graph of h(x) might look like this



e) none of the above